

## 4 The Second World War (1939 – 1945)

### Army Air Forces Aviation Construction for the War

The Second World War marks an immensely important period in the history of the U.S. Air Force. During the 6 short years of declared war in Europe, from 1939 through 1945, the U.S. Army Air Corps evolved from a second-tier air service, operating as an underappreciated subsidiary command of the Army, to the premiere air power of the world.

Its undersized and obsolete aircraft inventory grew into the world's largest, most advanced air force, possessing the most powerful weapon in human history. An articulated command structure and coherent doctrinal system also evolved, as the Army Air Forces acted with *de facto* autonomy throughout the conflict. These profound developments in the force were matched by parallel developments in its ground facilities, as the expansion programs begun during the Interwar Years were continued and substantially augmented. By the end of the war, the Air Force was operating out of a network of sophisticated air fields, training bases, and air depots that remain the nucleus of its infrastructure today.

#### MAJOR THEMES AND CONTEXTS

- The Wilcox Act – Second-Stage Expansion
- Prewar Construction – The 54-Group Plan
- Prewar Construction – The 84-Group Plan
- Wartime Construction – The 273-Group Plan

#### ***Prewar Mobilization and Construction***

Already in January of 1939, it was quite clear to American political and military leadership that the Army Air Corps was substantially under-strength in comparison to the air forces of other global powers. Steps were taken at that point to remedy the situation, but when German armored divisions plunged across the border of Poland in September 1939, America's air arm was still far from ready for the global conflict that would follow. A rapid series of substantial Air Corps expansion programs followed over the next 2 years, each calling for greater strength in combat groups, correspondingly expanded ground facilities, and increased funding appropriations. By the end of 1941 the newly constituted Army Air Forces were well on their way to establishing themselves as a viable air power with the necessary infrastructure of base facilities. Much work still remained when the first Japanese planes appeared over Pearl Harbor, but the nu-

cleus of the wartime system of aviation ground facilities was already in place. It would serve as the basis for the prodigious expansion that would occur over the following 4 years.

### Air Corps Expansion Programs

In January 1939, President Roosevelt was already aware of the relative weakness of the Army's air arm. He advocated an immediate expansion of the Air Corps to bring it in line with the air forces of rival powers. In April, Congress responded with an authorization to expand the Air Corps to a 24-group strength, with 6,000 aircraft, 3,200 regular officers, and 45,000 enlisted personnel. When German armored divisions invaded Poland in August, little had yet been done to execute this expansion. Plans would keep expanding from 1939 levels, faster even than the Air Corps could keep up. In mid-1940, as Hitler's blitzkrieg rumbled through France, Roosevelt called for a 50,000 plane Air Corps supported by production levels of 50,000 planes per year. Congress responded in late 1940 with the First Aviation Objective of 54 combat groups. That program had hardly begun to take effect before it was followed, in March 1941, by the Second Aviation Objective of 84 combat groups, which was to be met by mid-1942. In September 1941, the General Staff's Air War Plans Division published AWPDP/1, a long-range strategic forecast that advocated an Air Force of 239 combat groups. This plan was actually in place when America entered the war in December 1941, but would be expanded even further to a 273-group level before it could be implemented.<sup>1</sup>

Each of these expanding goals was supported by new levels of funding authorizations. The initial April 1939 plan for 24 combat groups passed through Congress with a \$300 million appropriation. This already exceeded the total funding for FY35 – 39, and even more phenomenal increases would be in store. Congress had intended to rein in these increasing funding levels with a planned FY41 appropriation of only \$29 million for the entire War Department for FY41, only \$5 million of which would be earmarked for the Air Corps. Events rapidly overtook this plan, however. When France fell in the spring of 1940, this appropriations bill was still under consideration. Roosevelt requested an unprecedented \$1 billion for national defense, driving the scale of appropriations irretrievably beyond prewar levels. Congress eventually passed a series of deficiency acts that went beyond even the President's requests, appropriating \$2.5 billion *for the Air Corps alone* — more than all the combined funding appropriated for military aviation

in the history of the U.S. to that point!<sup>2</sup> Clearly, financial support would no longer be a problem.\*

While the expansion programs passed through Congress during this period generally referred to increases in the number of combat aircraft — the 24-Group Plan, the 54-Group Plan, the 84-Group Plan — each also included substantial increases in personnel levels and necessitated massive construction programs to keep the Air Corps' ground facilities in proportion to its growing strength. Expanding numbers of aircraft also required more pilots, air crews, and ground crews, and Air Corps training programs were augmented to meet the need. By 1941, training requirements for pilots alone were up 10,000 percent over 1938 levels, with annual pilot classes of 30,000 expected in place of 300 at the earlier date. Technical training loads expanded at similar rates, reaching a level of 100,000 per year by the end of 1941. Consequently, a wholesale expansion of training facilities was required. Furthermore, every increase in the number of combat groups required expanded tactical air field facilities from which the groups could operate, and expanded depot facilities where aircraft could be stored, repaired, overhauled, and modified. The rapid establishment, expansion, and improvement of these three types of base facilities — tactical or operational air fields; training facilities for pilots, air crews, and ground crews; and air depots — would dominate the Air Corps' facility expansion efforts throughout the war. Despite record funding levels, the construction effort simply could not keep pace with the expanding mobilization effort.<sup>3</sup>

### Wilcox Act Expansion

The bulk of the \$300 million Congressional appropriation of April 1939 was earmarked for the acquisition of new aircraft. However, Chief of Air Corps General Henry "Hap" Arnold requested \$62 million of that sum for the expansion of base facilities. He actually received \$64 million for that purpose, and these funds were immediately dedicated to the establishment of those facilities that had been authorized under the Wilcox Act but had not yet had funds appropriated. Site

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\* The extent of Congressional support for Air Corps expansion programs is quite striking, as is apparent in one episode of an appropriations hearing in May 1941. During the course of this hearing, Congressmen interviewed military personnel as to the need for and distribution of various appropriations requests. Testimony regarding each request often fills many pages. That pattern is conspicuously broken, however, when it comes to Air Corps funding requests:

*Mr. Snyder:* Proceed with project No. 5 please.

*Major Hardin:* That is for Air Corps expansion.

*Mr. Snyder:* What is project No. 6?

selection for the Northeast, Southeast, and Alaska Air Bases, and the Rocky Mountain and East Coast Air Depots was announced in September 1939. Construction at these facilities began immediately, employing the standard field layout — and in some cases the standard hangar design — from earlier Wilcox Act construction efforts. Construction speed and efficiency were the top priorities and Air Corps leadership determined that all non-technical construction would be of a temporary nature.<sup>4</sup>

The Northeast Air Base (Westover Field) was established at Chicopee Falls, MA, the Southeast Air Base (MacDill Field) was founded at Tampa, FL, and the Alaska Air Base (Elmendorf Field) was established at Anchorage, AK. All three air fields employed the standard Air Corps diagonal runway layout (see Figures 3-15 and 3-16 in Chapter 3). Westover and MacDill Fields appear to have received essentially identical technical construction, featuring five standard steel-framed, bow-truss hangars. Elmendorf Field appears to have received only a single hangar in its original construction program. Construction at these facilities was completed by spring 1941.<sup>5</sup>

The Rocky Mountain Air Depot (Hill Field) was established near Ogden, UT, while the East Coast Air Depot was founded near Mobile, AL. A Hawaii Air Depot was established with expansions to Hickam Field, and both Patterson and Kelly Fields also received improvements under this program. Again, the construction at these fields followed the standards begun in earlier Wilcox Act construction. The current construction effort actually advanced the standard design process a great deal. Hill Field featured the first examples of the set of standard plans that characterize Air Depot construction through the end of the war. The main “Airplane Repair Building” at Hill and later depots consisted of four Air Depot Aircraft Maintenance Hangars situated in two outward-facing pairs, with an extensive shops annex connecting all four together by the back (Figure 4-1). Hill also features the first example of the “Transport Squadron Hangar” design, which featured steel truss construction in a flat-gabled profile with distinctive transverse monitors. Hill received only a single example of this type, but many depot projects included a double hangar of this design, consisting of two hangar bays connected longitudinally by a smaller administrative annex (Figure 4-2). Hill Field also featured a single Air Depot Aircraft Maintenance Hangar bay as a stand-alone unit, a feature that would be repeated at many bases of various types for the rest of the war. Finally, the Hill project included two 120-Foot



Temporary Hangars — a steel-truss, flat-gable hangar that was certainly the most often-repeated hangar type of the World War II era (Figure 4-3).<sup>6</sup> Hickam Field received “half” of an Airplane Repair Building, with one pair of Air Depot Aircraft Maintenance Hangars backed by the standard shops annex.\* Patterson and Kelly Fields each received a double Transport Squadron Hangar.<sup>7</sup> This construction, too, was largely accomplished by the end of 1941.

### **Corps of Engineers Supervision of Air Corps Construction**

It was already abundantly clear by late 1940 that Air Corps expansion was unlikely to slacken in the near future. It showed every sign, in fact, of growing with great rapidity, as new program followed new program in adding to its authorized force level. Nor was the Air Corps the only service in the Army that was expanding, and the Construction Division was beginning to feel the press as construction efforts mounted. In November 1940, oversight of Air Corps construction programs officially passed to the Corps of Engineers. This transfer was deliberately undertaken with a good deal of finesse in order not to disrupt construction activities already under way. The final transfer was not complete, in fact, before February 1941. Relatively few changes were made by the Engineers when they assumed authority of the construction effort. In particular, they continued the use of standardized plans. In fact, they expended considerable effort in improving and disseminating the designs that the Construction Division had developed for Air Depot use. In particular, the 120-Foot Temporary Hangar design began to be employed at a great number of fields of all types. The Engineers also continued the ongoing Air Corps policy of limiting permanent construction to technical facilities only, and limiting the number of these new facilities as much as possible.<sup>8</sup>

### **54-Group Plan Expansion**

The Corps of Engineers would not have to wait long to supervise its first Air Corps construction campaign. Already by December 1940, the expansion effort in support of the 54-Group Plan was well under way. Little tactical air field construction by the Air Corps had been planned for this program. Most of the new tactical fields — those field from which the new combat groups could conduct combat operations — were to be established by acquiring former Civil Aeronau-

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\* Hickam also received one more pair of the Type H Air Corps Double Hangars, although the remaining three that were originally planned were never constructed.

tics Administration (CAA) fields, and this organization was allotted almost \$100 million to conduct minor improvements at about 400 of these fields. Substantial expansion of training and depot facilities was necessary though, and the Engineers assumed control of this program.<sup>9</sup>

In June 1940, the Air Corps had established three new Flying Training Centers — one each in the Southeast, Gulf Coast, and West Coast regions. Each comprised a number of existing bases that were to be joined by new training fields to be constructed over the next year. In the Southeast, Maxwell, and Barksdale Fields were joined by the new Gunter Field and the new Eglin Field gunnery school (Eglin AFB). In the Gulf Coast region, Randolph, Kelly, and Brooks Fields were joined by a reactivated Ellington Field and the new San Angelo training field (Goodfellow AFB). On the West Coast, Moffett Field, newly acquired from the Navy in return for Rockwell Field, was joined by a new facility at the Stockton, CA, municipal airport. In addition, several civilian primary flight instruction schools were coopted into Air Corps service and substantially expanded. Relatively little new construction was involved in activating the new fields, although Goodfellow Field did receive three new hangars, one of which was a standard 120-Foot Temporary Hangar. In December 1940, 24 sites were selected for development as new training fields, to which were added eight training fields, two gunnery schools, and five cadet reception centers in March 1941. These new facilities included:

- Davis-Monthan Field, Tucson, AZ
- Kirtland Field, Albuquerque, NM
- Luke Field, Phoenix, AZ (improvements at an existing field)
- Mather Field, Sacramento, CA (improvements at an existing field)
- Nellis Field Gunnery School, Las Vegas, NV
- Tyndall Field Gunnery School, Panama City, FL.

The construction necessary to bring these fields into operation varied by site, but most included at least one 120-Foot Temporary Hangar, and Mather Field received one steel OBH-1 Hangar and three standard Two Unit Hangars. This latter design was employed at a number of training bases — especially technical training bases — and consisted of two standard 120-Foot Temporary Hangars joined longitudinally (Figure 4-4). Most of these new facilities were operational by June 1941, although the gunnery schools were delayed until late fall.<sup>10</sup>

Three new Air Depot sites were also established in support of the 54-Group Plan, with site selection completed by April 1940. These new depots were located at Oklahoma City, OK (Tinker Field), Rome, NY (later Griffiss AFB), and Macon, GA (Robins Field). These were the first air depot construction projects directly

supervised by the Corps of Engineers, and the new and improved standard plans were employed. Each of the three fields received one Airplane Repair Building complex with the four standard hangar bays and connecting shops annex, and one double Transport Squadron Hangar in its original construction (Figure 4-5). The technical construction at these facilities was completed by fall 1942. However, each depot also received some expansion construction later in the war.<sup>11</sup>

### **84-Group Plan Expansion**

The 84-Group Plan followed hard on the heels of the 54-Group Plan, passing through Congress in March 1941. As with its predecessor plan, new training and depot facilities were necessary to support the augmented force level, and an expansion and construction program began immediately. By summer, sites were selected for 20 new flying training fields, one gunnery station, and a reception center, as well as two new air depots. Contracts were also placed with 17 civilian training agencies in order to accommodate the flood of incoming pilot cadets. In addition, March 1941 brought the establishment of the Technical Training Command, which assumed control of all ground crew training activities. Two new technical training centers were established by this command in conjunction with the 84-Group construction program.<sup>12</sup>

The 20 new flying training fields included eight installations that would go on to become permanent Air Force installations at:

- Merced, CA (Castle AFB)
- Victorville, CA (George AFB)
- Valdosta, GA (Moody AFB)
- Enid, OK (Vance AFB)
- Sumter, SC (Shaw AFB)
- Lubbock, TX (Reese AFB)
- Chandler, AZ (Williams AFB)
- Columbus, MS (Columbus AFB).

Each of these fields featured some permanent technical construction, dominated by standard Type DH-1 double aircraft hangars. The first five of the bases listed above received one to four of these hangars, each of which featured two steel-truss, closed-arch bays connected by a distinctive peaked mid-section and flanked with pried door pockets (Figure 4-6). Moody also received two standard 120-Foot Temporary Hangars, and Vance received a single Transport Squadron Hangar. Williams Field featured two standard steel OBH-1 Hangars. Only Reese Field received what appears to be nonstandard construction, in the form of modified DH-1 hangars that exhibit a distinctive gambrel profile with arched

outer angles. This design may conceal the standard peaked mid-section or may have been influenced by a standard CAA design. Regardless, it does not appear at any other active military fields (Figure 4-7). No evidence could be found for the nature of the technical construction at Columbus Field. Technical construction was completed at these fields by early 1942.<sup>13</sup>

The two depots established in conjunction with the 84-Group Plan were sited at Spokane, WA, and San Bernardino, CA. The Spokane depot (Fairchild AFB) received the standard Airplane Repair Building complex, two 120-Foot Temporary Hangars, and one other large, wood-truss, flat-gable hangar. The San Bernardino depot (Norton AFB) also featured the standard Airplane Repair Building complex, two OBH-1 Hangars, and two steel-truss monitor hangars with distinctive counterweighted, swing-up overhead doors. These latter hangars conform to a later standard design entitled "Expandable for Very-Heavy-Bomber Aircraft," although this aircraft type was not to be introduced for a number of years (Figure 4-8). Technical construction at the Spokane depot was completed by summer 1943 and at San Bernardino by early 1944.<sup>14</sup>

The two training centers established by the Technical Training Command were located at Biloxi, MS (Keesler Field), and Wichita Falls, TX (Sheppard Field). Both schools received five standard Two Unit Hangars, which appear to have been the Technical Training Command's preferred hangar design (Figure 4-9).<sup>15</sup>

The Technical Training Command's repeated use of the standard Two Unit Hangar raises an issue worth emphasizing at this point. Not only was there a substantial amount of standardization across the entire Air Corps construction program during this period, but there appears to have been an appreciable amount of more precise standardization within particular programs. Air depot construction is an obvious example, as each depot featured distinctive standard hangar types, including the Aircraft Repair Building complex and the single or double Transport Squadron Hangar. But other types of facilities exhibit this sort of base-specific standardization as well. Flying training bases established for the 54-Group Plan tended to feature 120-Foot Temporary Hangars. This base type for the 84-Group Plan used DH-1 hangars. Technical training facilities featured the Two Unit Hangar. As will be seen, these trends also extended to later periods.

### ***The Formation of the U.S. Army Air Forces***

About the time the 84-Group Program began to swing into motion, the Army took another significant step to ready American air power for the total air war

that would characterize World War II. In June 1941, the War Department created the U.S. Army Air Forces. Still officially a sub-service of the Army, the Army Air Forces would act essentially as a separate service branch throughout the war. This was the only way that such an immense effort could be efficiently organized and controlled. With its own Undersecretary of War and equal representation on the General Staff, the Army Air Forces were only one step away from the independence they had sought so ardently throughout the preceding generation.<sup>16</sup>

Throughout the first 2 years of the conflict in Europe, Army and Air Corps planners had watched with growing interest and concern the development of air power by combatants of both sides. The stark realities of modern air power had been amply demonstrated by Germany's use of tactical air power in its blitzkrieg offensives. The possibilities for strategic air power were also being revealed during the German bombing campaigns in the Battle of Britain. By mid-1941 it was abundantly clear that even the substantial expansion that the Air Corps had achieved to that point would be inadequate in the coming struggle. In September 1941, as noted previously, the General Staff's Air War Plans Division published AWPD/1, a long-range strategic forecast that advocated an Air Force of 239 combat groups. This plan was actually in place when the U.S. entered the war in December 1941.<sup>17</sup> Another construction campaign was slated to accompany this massive expansion, with plans to establish 14 new air fields in early 1942. This program was immediately superseded, however, after the Japanese attack on Pearl Harbor. The air power equation was immediately altered at that time, and the recently launched 239-Group Plan would rapidly be supplanted by a 273-Group Plan, with a corresponding expansion of the base construction program.

#### **Wartime Mobilization and Construction**

Within 1 week of the Pearl Harbor attack, the Air War Plans Division had released AWPD/4, a long-range strategic plan that called for an Air Force of 273 combat groups. While this plan was not accepted at the time, the debate within the military community that raged over the next year eventually produced AWPD/42, which also called for that same force level to be met by December 1943. Regardless of the debate, it was clear to Army Air Forces leadership that a massive expansion would be necessary for U.S. air power to play the decisive role it anticipated for itself in World War II. Substantial expansion of base facilities within the U.S. would, of course, be necessary to support this buildup. General Arnold clearly intended this war to be fought overseas, and he anticipated that no more than one-third of the Air Forces combat strength would be deployed in the U.S. at any one time. Nevertheless, until the time came to deploy the grow-

ing air armada to Europe and the Pacific, the newest plan would require operational bases in the U.S. from which to conduct continental air defense, training bases at which an unprecedented number of pilots, air crews, and ground crews could be trained, and depot facilities at which its aircraft could be stored, repaired, and modified. Because the force level of 273 combat groups was to be attained by the end of 1943, corresponding basing facilities had to be available by that time as well. The immense task of meeting these requirements was met head-on by the Air Forces and the Corps of Engineers, and most of the necessary air fields were indeed operational by the appointed time. By the end of 1943, the Army Air Forces operated out of some 345 main bases, 116 sub-bases, and 322 auxiliary air fields, the most at any time in its history.<sup>18</sup>

It was absolutely clear that speed and efficiency were crucial to the success of the building program. Air Forces and Corps of Engineers leadership determined immediately that all construction would be of a Theater of Operations type to allow for maximum speed and ease of construction, with minimum expense. The single exception to this rule was technical construction, which mostly was intended to be permanent. Some wood construction does appear to have been adopted, especially in areas where lumber was cheap and plentiful — in the Northwest and Alaska, for example. All construction was to be of the simplest type possible, using substitutions for steel sheeting and piping, copper flashing and wiring, stainless steel, and cast iron. Almost everything except structural members for technical construction was included in the list of materials for which cheaper substitutions were sought. Not surprisingly, the wartime construction program employed most of the same standard designs that had dominated prewar expansion programs.<sup>19</sup>

#### **Early Defensive Dispersal Programs and the Continental Air Defense**

The Army Air Forces had not experienced an auspicious beginning to the conflict, as its forces were caught largely off-guard by the Japanese and destroyed on the ground throughout the Pacific. The first task of the wartime construction program was the immediate dispersal of aircraft at bases on both coasts to prevent a recurrence of this disaster. The dispersal campaign spurred major construction activity at more than 100 sites across the country, consisting primarily of aircraft hardstands and revetments, dispersal taxiways, and temporary sand-bag aircraft shelters. This campaign was short-lived, however, as it became clear that the threat of a second Japanese surprise attack was relatively remote. By February 1942 the panic had passed and in March, Air Forces leadership prohibited any further dispersal construction.<sup>20</sup>

The numbered Air Forces that had been established in the continental U.S. in March 1941 each conducted expansion within its area to provide operational bases for its growing strength.\* The 1st and 4th Air Forces each established a number of new bases; most were designed to accommodate a single pursuit squadron, but a few were more substantial. The 3rd Air Force was able to meet its limited defense obligations with no expansion, and the 2nd required only minor construction at existing bases. The majority of these new facilities were acquired from the CAA, but a few entirely new bases were established, including Andrews Field at Camp Springs, MD, and Dover Army Air Base at Dover, DE. The CAA received \$192 million for further expansion and improvement of its facilities, but was informed that this would be the last appropriation of its kind. By the end of 1943, most construction at these fields was completed.<sup>21</sup>

### Training Field Construction

The Air Forces' most pressing need was for new training facilities to accommodate a vastly expanded training load for pilots, air crews, and ground crews. The pilot training load increased to 70,000 cadets per year in response to the 273-Group Plan, and technical training exploded to some 600,000 personnel per year. The AAF Flying Training Command was established in January 1942, and site selection for its new facilities followed immediately thereafter. By May 1942, 50 new fields were in operation, although technical construction often lagged far behind. The bulk of these new bases were situated in the Southwest, where flying conditions were best, but already these areas were becoming overcrowded and some expansion into less ideal areas of the plains states was necessary. It appears as though one standard 120-Foot Temporary Hangar was included in the technical construction at these new bases, along with other structures as needed, which often included standard OBH-2 Hangars (which were wooden, in contrast to the steel OBH-1 design). This hangar complement could be found at the new fields at San Angelo, TX (later Goodfellow AFB), and Altus, OK (later Altus AFB). The Flying Training Command also took over and adapted some combat bases, and adapted some CAA fields to its use, including Kirtland Field at Albuquerque, NM, and Carswell Field at Fort Worth, TX. Each of the new fields also required the establishment of one auxiliary landing field per 100 cadets, but these facilities rarely required technical construction.<sup>22</sup>

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\* The 1st Air Force was established in the Northeast, the 2nd in the Northwest, the 3rd in the Southeast, and the 4th in the Southwest.

The 2nd Air Force assumed responsibility for all bomber training in January 1942, and established five new fields for the purpose, including Davis-Monthan Field in Tucson, AZ. By April, it added four new bases, including one at Great Falls, MT (later Malmstrom AFB). This facility received one standard Air Corps Double Hangar Type E-E — one of the 1930 standard plans — as well as a standard OBH-1 Hangar and a 120-Foot Temporary Hangar. By July, four new oversized fields were added for blind landing training, including those at Clovis, NM (Cannon Army Air Field), and Mountain Home, ID (Mountain Home AAF). Each received extended 10,000 ft runways and four hangars; those at Mountain Home were the distinctive Birchwood Hangars, which featured wood bow-truss construction (Figure 4-10). Soon thereafter, nine other primary fields were added, including an expansion of the Alamogordo Bombing and Gunnery Range (Holloman AAF, NM). All of these bases were operational by spring 1943, after which no more new construction was authorized for the 2nd Air Force.<sup>23</sup>

The 3rd Air Force assumed responsibility for medium-, light-, and dive-bomber training. Existing CAA fields could be adapted for this type of use with relative ease since these aircraft did not require oversize housing or extended runways. By May 1943 the 3rd Air Force was operating out of 11 main bases, 23 sub-bases, and 16 auxiliary fields. All but two of the main bases had been built before Pearl Harbor, and most of the subsidiary facilities were CAA fields with only limited improvements.<sup>24</sup>

The Technical Training Command was also forced to expand its operations to accommodate astounding force levels by 1943. By March of that year, eight new technical training fields were rushed into service, including Seymour-Johnson Field, in Goldsboro, NC. Like the prewar facilities at Biloxi and Wichita Falls, Seymour-Johnson received four standard Two Unit Hangars and one 120-Foot Temporary Hangar. Even with these new fields, however, the Technical Training Command required many more training facilities than could be constructed in a timely manner. An innovative solution was reached through the leasing of a large number of hotels and conference centers in tourist areas that would otherwise have been left vacant in the absence of regular seasonal crowds.<sup>25</sup>

#### **Construction for the Air Materiel Command**

The Air Materiel Command was established in March 1942 as the successor to the Air Corps Material Division, and it was tasked with the testing, development, and procurement of new aircraft and weapons for the Army Air Forces. It required relatively few new facilities, but did receive substantial construction for its headquarters at Wright Field. Between June 1940 and September 1945,



nearly \$49 million was spent on improvements at Wright Field alone, by far the highest amount allocated to any one air base in the nation. This expansion included the construction of five new hangars, and three more were also constructed for the adjoining Air Depot at Patterson Field, which supported testing and modification work. At Wright Field, three large standard steel-truss, open-arch hangars were erected, joined by two nonstandard multiple-bay steel-truss testing hangars (Figure 4-11). Patterson Field received a single standard OBH-2 Hangar (wood) and another of the ubiquitous 120-Foot Temporary Hangars. All of these new structures were completed in 1943.<sup>26</sup>

The Air Materiel Command also expanded at Eglin Field, FL, with its immense Air Corps Proving Grounds in the Choctawhatchee National Forest. By April 1942, this installation was granted independent command status, and established 10 auxiliary fields spread across its reservation, at which crucial testing and training operations were conducted throughout the war. Eglin received five of the standard 120-Foot Temporary Hangars, which were all completed by 1943 (Figure 4-12). In 1945, construction was begun on an experimental Climatic Hangar, a large refrigerated structure for testing aircraft performance under adverse weather conditions. This unique facility was still under construction at war's end, and the first tests were not conducted there until May 1947.<sup>27</sup>

### **Consolidation and Downsizing**

Air Forces activity of the continental U.S. peaked in the latter half of 1943. The immense effort that had been expended in readying American air power for its crucial missions in Europe and Japan had come to fruition by that time, and the bulk of Air Forces strength was already beginning to transfer overseas to Europe and the Pacific. With operational units deployed to foreign stations, with training missions no longer expanding, and with the continental defense mission having essentially vanished, there remained little reason for further airbase expansion and construction. Most of the Army Air Forces construction effort had been scheduled for completion by the end of 1943, and relatively little was contemplated for beyond that time. Beginning in the latter half of 1943, increasingly tight restrictions were placed on requests for new construction, culminating in General Arnold's February 1944 order prohibiting any further construction in the continental U.S. without his personal approval. However, ongoing construction projects that had yet to be completed in 1943 still amounted to some \$500 million in outstanding contracts, and those already authorized for 1944 totaled \$168 million. While these were substantial sums of money by any standard, they were only a fraction of the \$2 billion-plus figure of 1941.<sup>28</sup>

### The Army Air War

The Army Air Forces had certainly fared poorly in the opening days of the war, losing much of its forward-deployed strength on the ground to Japanese air attacks. Much of its equipment at that time was obsolete and unfit for modern service, but that would soon change. From the first tentative reprisal against the Japanese home islands during the Doolittle Raid of 18 April 1942, the Army Air Forces made steady strides toward achieving victory in the war. At the same time, they advanced on a long-elusive goal: independence as a service.

Nominally dedicated to a Germany-driven strategy, the Army Air Forces began a slow buildup of bomber strength in England in anticipation of the strategic air campaign against the Third Reich. While necessary commitments of force to the Pacific theater slowed this expansion to some degree, the first attacks on German-controlled Europe by American bomber forces were flown by B-24 Liberator heavy bombers against the Ploesti oil fields of Romania in June 1942. These raids had been staged from bases in Egypt. The first strikes against Western Europe from English bases were conducted by A-20 Havocs against railyards in northern France in July. The first B-17 raids followed in August, and continued unabated until the German surrender in May 1945. These nonstop raids are credited with sapping Germany's warfighting capability through attacks on military, industrial, and population center targets.<sup>29</sup>

The strategic air campaign over Europe was conducted by combined British and American air forces, organized into the Allied Strategic Air Forces. The original American contribution to this body was the 8th Air Force, which at first incorporated strategic and tactical air assets. By the end of 1943, the 9th Air Force was moved to England and assumed command of tactical air operations, thus forming the 8th Strategic Air Force and 9th Tactical Air Force — precursors of the post-war command system that included SAC and TAC.<sup>30</sup> This reorganization was the result of lessons learned by the Army Air Forces over the sands of North Africa in the autumn of 1942. The Allied air forces had entered the conflict in that theater under the control of the local ground forces commanders. It quickly became clear that the resulting concentration of air activity on ground-support missions, without first gaining air superiority, led to extremely high casualties and ineffective support operations. It was decided that the air assets should be consolidated under the control of single command structure of the 12th Air Force. Its commander, General Carl Spatz, was free to shift his air assets as he saw fit, and was able to concentrate his forces to gain unquestioned air superiority over his German adversaries. Having done so, he was then able to better

support the Allied armies among which the air assets had originally been dispersed.<sup>31</sup>

This new organizational system served the Allies very well through the height of the war, as the 9th Air Force was able to provide extremely effective air support to the Allied armies driving across Western Europe following Operation Overlord in June 1944 — especially after the arrival of powerful fighter-bombers such as the P-47 Thunderbolt. Meanwhile, B-17s and B-24s of the 8th Air Force maintained their strategic bombing campaign against German industry and morale, augmented by long-range fighter escorts such as the P-38 Lightning and P-51 Mustang. The same organizational and doctrinal concepts applied in the Pacific Theater as well, as the 5th, 7th, and 13th Air Forces supported the island-hopping campaigns across the Southern and Western Pacific, and the 10th and 14th Air Forces did the same in India and China. This area also benefited from the activities of the Air Transport Command — a precursor to MAC in the post-war years — as it flew supplies over the Himalayas from Burma to China.<sup>32</sup>

The 20th Strategic Air Force (SAF) was organized in April 1944 to conduct the strategic bombing campaign against the Japanese home islands from bases in the Central Pacific. The 20th SAF was a unique organization in three important ways. First, it was the only Army Air Force command to fly the giant B-29 Superfortress, the largest Very Heavy Bomber built to that point, with immense payload, high operational speed and altitude, and incredibly long range. Second, it reported directly to the Joint Chiefs of Staff and not to the local Theater Commander. This was the specific intent of General Henry H. “Hap” Arnold, Commanding General of the Air Force, who intended to demonstrate that a modern industrial nation such as Japan could be defeated through the use of strategic air power. He therefore molded the 20th Strategic Air Force to his vision of an independent postwar Air Force. Third, the 20th was the only Air Force — the only armed force in history in fact — to employ nuclear weapons against an enemy. While individual fire-bomb raids had actually inflicted heavier casualties than either atomic bomb attack would, the psychological effect of a single weapon of such explosive force had the desired effect, spurring the precipitate surrender of the Japanese government on 14 August 1945.<sup>33</sup>

#### **Training Facilities for B-29 Crews**

Most of the new construction undertaken over the last years of the war involved the expansion of existing training facilities to accommodate the introduction of the new Very Heavy Bomber — the B-29 Superfortress that played such an important role in bringing the war in the Pacific to a successful conclusion in 1945. Most of this activity actually centered on runway and apron improvements that

were necessary to support the immensely heavy new aircraft. Pavements able to withstand 120,000 lb gross loads were required — some 10 times greater than that required by the B-17. Barracks were also constructed to accommodate the unprecedented manpower levels of the Very Heavy Bomber groups. However, relatively little hangar construction was called for. The Corps of Engineers constructed 18 hangars at 11 fields for this purpose, and it appears that the two standard Type R-A Heavy Bombardment Hangars constructed at Maxwell Field in 1945 may have been typical of this program (Figure 4-13).<sup>34</sup>

#### **Downsizing During the War**

Not only did the Army Air Forces conduct little construction over the last 2 years of the war, but they actually began to dispose of excess properties before the war had even come to an end. By late 1943, with the bulk of Air Forces strength deployed overseas, personnel were not available even to occupy existing facilities, let alone utilize them to their full capacity. Therefore, Air Forces leadership embarked at that early date on a program of phased drawdown in basing facilities. Most of the leases at hotels and civilian training centers were abruptly terminated in 1944. Seventy-nine surplus air fields were excessed either to the Navy for carrier training or to the Army Service Forces for disposal. More than 150 other air fields were mothballed, and released immediately upon the surrender of Japan in August 1945. By the end of December 1945, the Army Air Forces retained only 279 main bases and sub-bases, and 156 auxiliary fields. The Army Air Forces were already on the way to demobilization.<sup>35</sup>

#### ***Impact of Army Air Forces Construction on the War Effort***

WWII did indeed mark a pivotal stage in the development of American air power. The Army Air Forces had made crucial contributions to the Allied war effort and had, in the process, made great strides toward becoming the premier air power that it is today. It accomplished a stunning expansion, growing from the 6th largest air force in the world with less than 25,000 men and 525 aircraft in service, to the largest in the world with a peak strength of more than 2.37 million men and 80,000 aircraft. It had acted as a *de facto* independent branch of service, and evolved an efficient organizational structure that would form the basis of its postwar command framework. It had proven in decisive fashion the validity of the strategic air power concept that had led its advocates through the preceding decades. Moreover, it had succeeded, in the space of a few short years of intense, all-out mobilization, in establishing the substantial infrastructure from which it would operate in the postwar world. More than \$3.1 billion had been spent on this expansion program over the course of the war. Perhaps the best indication of the level of success achieved in this construction endeavor is that

the Army Air Forces experienced no appreciable delays in mobilization, training, or expansion that were attributable to a lack of ground facilities.

## **Army Organic Aviation and Construction**

U.S. Army organic aviation took its first major steps toward becoming an identifiable service branch during World War II and the years immediately preceding. Concentrating on light aircraft operations in direct support of Army ground forces, organic aviation operations constituted an integral part of the landscape at almost every Army installation. Because of its very nature, however, little infrastructure was necessary to support these operations, and related construction activity was therefore kept to a minimum.

### ***Proving the Organic Aviation Concept for Ground Support***

U.S. Army organic aviation had its origins in the debates that raged over air power doctrine in the 1920s and 1930s. While Air Corps leadership was drawn more and more to aerial warfare's strategic potential, embodied in the heavy bomber, ground forces commanders stressed the traditional tactical support roles of Army aviation. In particular, members of the artillery branch emphasized the need for aerial spotting and direction of indirect artillery fire, and advocated the development of a light observation plane for these purposes. They argued that the aircraft provided by the Air Corps were too few in number, flew too fast and too high, were too hard to maintain, and required elaborate operating fields that were simply unavailable at the front. The artillerymen's solution — permanent attachment of light aircraft to their units — found little favor with Air Corps officials. These aviation visionaries were reluctant to supply aircraft and pilots to ferry around artillery observers, as this may have endangered their hard-won combat roles. On the other hand, they were no more happy with the idea of organic flight units in other service branches, which could constitute a threat to their own ultimate control over Army aviation assets.<sup>36</sup>

As early as the 1920s a system of very simple flying fields was established at almost every major Army installation. The primary purposes of these fields were (1) to provide landing sites from which simple spotter aircraft could operate during joint ground forces-Air Corps exercises; (2) to provide facilities where active and reserve personnel could learn to fly and be exposed to the possibilities of aviation for the support of ground operations; and (3) to act as airway stations. Most of these simple fields did not include permanent hangar facilities. Those that did were the exceptions to the rule, and these appear to have been operated by the Air Corps for training and exercises with ground forces units.<sup>37</sup> The pri-

many examples of this sort of activity were at Fort Sill, OK, and Fort Knox, KY. Fort Sill was the site of the Army Artillery School, and a fair amount of airborne artillery spotting training was conducted there throughout the Interwar Years. In 1932 a standard 1930-E Hangar was erected at the field to support this training activity, and in 1935 a balloon hangar was erected for the same purpose.<sup>38</sup> Fort Knox was the site of the Cavalry School, where much of the Army's experimentation with armored warfare was conducted, and a fair amount of flying activity characterized operations at that installation in support of large-scale maneuvers. Even so, the only hangar facilities at Knox were a few U.S. All-Steel Hangars left over from World War I.<sup>39</sup> With these examples as the high-water mark of technical construction for organic aviation, it is clear that the bulk of the ground forces' flying fields, conservatively speaking, must have been rather simple facilities. This should not be surprising, however, given the emphasis of organic aviation on simplicity, durability, and the ability to operate from primitive fields.

The first real forward step in the development of organic light aviation was taken in the summer of 1940 when a young artilleryman, Lieutenant Thomas McChord Watson, Jr., decided that the Piper Cub would be an ideal artillery spotting platform. He invited the Piper Aircraft Company to supply a single aircraft to support maneuvers in Louisiana. Its performance there caught the notice of some higher Army commanders, including Brigadier General Adna R. Chaffee, who became interested in the bureaucratic melee between the ground forces and the Air Corps. Chaffee saw great potential for such light airplanes in directing armored columns and supporting artillery batteries. In February 1941 he issued a statement calling for the assignment of organic aviation assets to all ground branches of the U.S. Army. In May 1941 Major William Ford added his support to Chaffee's proposal. An artillery officer, Ford conducted tests comparing the performance of dedicated spotter aircraft operated by artillery units themselves to that of spotter aircraft supplied by the Army Air Forces. Ground forces observers were much more impressed with their own dedicated artillery spotters than those attached to Army Air Forces, particularly in terms of superior aircraft availability and response times. Field exercises in June confirmed these results as light planes performed artillery observation, reconnaissance, and transport duties very successfully from small, unprepared fields. Lieutenant General Ben Lear recommended, at the conclusion of those maneuvers, that light aircraft be made a permanent component of artillery units. More maneuvers in July and August served to reinforce the point, as the availability and versatility of the light aircraft was demonstrated in observation, artillery spotting, and tank unit direction roles. Still, the War Department was unconvinced and demanded further tests before approving organic air assets for ground units. Resolution of

the issue was postponed by the disaster at Pearl Harbor, however, and organic aviation for artillery units would have to await later developments in the war.<sup>40</sup>

### ***Inauspicious Wartime Beginnings***

The final division-level exercise was run from February to April 1942, under the supervision of now Lieutenant Colonel Ford, and once again showed quite clearly that artillery units could efficiently employ light aircraft. The War Department was finally convinced, and Army organic aviation was authorized on 6 June 1942. The directive published that day called for an air element of two planes, two pilots, and one mechanic to be assigned to each artillery battery, as well as one extra element attached to each field artillery brigade headquarters and each division artillery headquarters. Ford, by now a full colonel, assumed command as director of the new Department of Air Training at the Fort Sill artillery school, which had been transferred to the Army Ground Forces from the Army Air Forces.<sup>41</sup>

The first class at Fort Sill's Post Field, in September 1942, consisted of 19 men who began training in Piper L-4Bs, Taylorcraft L-2Bs, and Aeronca L-3Cs. Each pilot candidate had to arrive with his private pilot's license and 60 hours of solo time. The training curriculum at Fort Sill concentrated on advanced subjects such as navigation, weather, maintenance, tactics, and observation. The stringent entry requirements soon had to be lowered as the pool of qualified candidates quickly emptied. In response to this shortage, the Army Air Forces began to supply qualified personnel from its own ranks. This solved the immediate shortage of qualified trainees, but Fort Sill alone could not accommodate all the pilots that were needed. Consequently, two new training fields were opened and run by the Air Forces at Denton, TX, and Pittsburg, KS. There was a further complication, however, as Ford's original plan to rely primarily on pilots of enlisted rank proved impracticable due to a high trainee attrition rate. By April 1943 only officers were being accepted into flight training.<sup>42</sup>

Army Air Forces leaders planned a substantial base establishment for organic aviation activities, including four large regional bases and fully equipped air fields attached to each Army post. In the end, this proved unfeasible and unnecessary. No regional fields were established, although most permanent posts did receive an associated air field. These fields were of very basic construction, however, and no evidence of new technical construction is associated with them or the training fields established for Army pilots.<sup>43</sup>

The first combat assignment, in support of Operation Torch, was less than a resounding success. Two of the five participating planes were shot at by their own

invasion force as they flew in toward the beach, and they were forced to crash land. No one was killed, but it was not an auspicious beginning for the Army's air mission. As the war progressed, however, Army aviation played a growing number of important roles, including reconnaissance, artillery spotting and adjustment, transport, column guidance, wire laying, pathfinder activity, search and rescue, and messenger flights in the ubiquitous Piper L-4 and Vultee L-5. By the end of hostilities, the War Department had approved the inclusion of organic aviation units for all combat arms. The road to acceptance was not always a smooth one as traditional commanders balked at employing the new techniques. Gradually, however, the widespread use of light aviation caught on and many improvised procedures took hold as well.<sup>44</sup>

### ***Overall Impact on Aviation Infrastructure***

Like the Army Air Forces, Army organic aviation made great strides throughout the course of World War II. The activities of these early light aircraft pilots laid the foundation for later developments that would bring aviation operations to the forefront of Army activities. Unlike the Army Air Forces, Army organic aviation appears to have received essentially no technical construction to support its activities — even at training fields. The development of such ground facilities would have to wait for the end of the war, and the coming bureaucratic struggle over an independent Air Force.

## **Navy and Marine Corps Aviation Construction for World War II**

WWII and the years immediately preceding it constituted a most important period in the development of naval aviation and the Navy's aviation shore establishment. Events of WWII confirmed the growing opinion among Navy leaders that naval aviation was the single most decisive combat arm at sea. The aircraft carrier became recognized as the dominant capital ship in the fleet. Devastating air raids on enemy battle fleets conducted by the British at Taranto in 1940 and the Japanese at Pearl Harbor on 7 December 1941 answered the question of whether aircraft could damage or destroy capital ships in a combat situation. The Battle of Coral Sea in May 1942, followed by a series of subsequent naval engagements decided principally by carriers and their aircraft, ushered in the age of modern naval combat. Henceforth, opposing fleets would rarely come within sight of each other, but would instead locate the enemy by means of aerial reconnaissance, strike with carrier-borne attack aircraft, and defend themselves with carrier-

### **MAJOR THEMES AND CONTEXTS**

Hepburn Base Program Construction  
15,000-Plane Program Construction  
Wartime Construction



borne fighters. No longer would the great battleships rule the waves, as they were shouldered aside by the aircraft carrier — to be joined later by a great variety of missile-armed vessels.

Given the importance of naval aviation in this period, it is not surprising that the air arm of the U.S. Navy developed and expanded at an unprecedented rate. In 1938 the Navy had been authorized a total air strength of only 1,000 aircraft, which was expanded under the Vinson-Trammell Navy Bill to 3,000. At this time the Navy operated 8 aircraft carriers, supported by 11 air stations and eight reserve air bases. By war's end, more than 100 carriers and over 37,000 aircraft were in operation, and the shore establishment had expanded to more than 200 air installations of all types spread across the entire country. Between 1939 and 1945, more than 67,000 aircraft were acquired by the Navy and 38 different air stations had received more than \$10 million in construction appropriations.

Like the Army, the Navy experienced a great deal of its air station expansion in the period just before the U.S. entry into the war and during the first year of hostilities. During 1939 and 1940, the Navy made an enormous effort to fully develop the system of naval air stations recommended by the Hepburn Board in December 1938, which had been designed to meet the needs of the 3,000-plane program of the 1938 Naval Expansion Act. With the outbreak of war in Europe, and the dire straits in which the Allies found themselves by mid-1940, substantial expansion of the Hepburn Plan was approved to accommodate growth of the Navy's air arm to 15,000 aircraft. Much of this work had been accomplished by the time Japan launched its surprise attack on Pearl Harbor. The network of naval air stations established during this crucial period constitutes the bulk of the Navy's aviation shore establishment today. Nevertheless, a great deal of new expansion was accomplished after Pearl Harbor, under emergency conditions, to keep pace with the rapidly growing air arm as the U.S. took the war across the Pacific to Japan. Most of this wartime expansion took place in 1942.

By mid-1943, the Navy's construction effort had already begun to taper off, but not to the extent that the Army's had. Indeed, as the Army Air Forces began to phase down their air base establishment, excess facilities were acquired by the Navy in an attempt to minimize the cost of continued expansion. While Congress had essentially granted every Navy request during the crisis period of 1942 and early 1943, it resumed close oversight of the construction program throughout the rest of the war, and a great number of projects requested by the Navy were eliminated by Congress due to fiscal considerations. The close of hostilities brought an almost total revocation of outstanding construction funds, but by that time the immense effort of the preceding 5 years had established most of the Navy's current aviation shore infrastructure.

## ***Buildup for the Naval Air War***

### **The Hepburn Base Expansion Plan**

The origins of the Navy's pre-WWII buildup can be found in the Naval Expansion Act of 1938. This law called for an across-the-board increase of 20 percent in the Navy's surface-vessel strength, augmented by an increase in the approved aircraft complement to 3,000 planes. Of course, expansion of this magnitude had to be matched with a construction program to provide the necessary aircraft support facilities. Congress authorized the composition of a committee of naval officers, headed by Rear Admiral A. J. Hepburn, to investigate the problem and report on Navy's requirements for increased shore facilities.

The Hepburn Board convened in late 1938, reporting out to Congress on 1 December of that year. The board found that the Navy aviation shore establishment required significant expansion. This was due not only to the anticipated expansion of the aircraft inventory, but also to the fact that Navy construction had not sufficiently kept pace with previous aircraft expansion and was therefore already terribly short of these crucial support facilities.

The board recommended the establishment of a network of air stations around the coast of the continental U.S., and in Hawaii and Alaska. These air stations were categorized into three classes: (1) *major air stations* that could conduct assembly and overhaul work in addition to supporting regular air operations; (2) *secondary stations* intended only to support regular operations; and (3) *designated training stations*. The board recommended that the East and West Coasts each end up with three major stations — either new construction or expansion of existing bases — to be supported by a number of secondary stations. In addition, it recommended that the Navy's sole training base at Pensacola be expanded, and that a new training base be established somewhere on the Gulf Coast. The scope of each of these bases was expressed in terms of air group capacity rather than in terms of specific building lists. Each of the major stations was expected to accommodate two to four carrier groups, three to six patrol squadrons, and two utility squadrons. Each major air station was also to provide facilities for aircraft overhauls. The planned capacities of the secondary stations showed more variety, although support of one to four carrier groups was typical. These secondary stations were to be located in areas where they could serve as auxiliary fields for the major stations when necessary.

The Hepburn Board identified NAS Norfolk as the only existing major station on the East Coast, and recommended the establishment of two new major stations to round out the aviation shore establishment in the east. A Southeast station

was to be located at Jacksonville-Banana River, FL, and a Northeast station was slated for Quonset Point, RI. On the West Coast, San Diego, Alameda, and Seattle were already in operation as major stations, and were to be joined by a new secondary station at Tongue Point, OR. Overseas, the major station at Pearl Harbor was to be augmented by a new one at Kaneohe Bay, HI, and three new stations were to be established in Alaska at Kodiak, Dutch Harbor, and Sitka. Furthermore, eight new operational bases were to be established on various mid-Pacific islands, with a ninth at San Juan, PR. Finally, the new training station was to be established at Corpus Christi, TX. In all, the Hepburn Board recommended that all 11 existing stations receive substantial expansion, and that 16 new stations be established. Of the 16 new stations, only Jacksonville, Quonset Point, Tongue Point, Kaneohe Bay, Kodiak, Dutch Harbor, and Sitka are in what is now considered the United States.

Finally, since the required number of carrier groups and patrol squadrons would generate an insupportable amount of air traffic for a single flying field, the Board recommended that each base also be provided with a number of outlying auxiliary fields. The Hepburn Base Program was authorized by Congress and signed by the President on 25 April 1939.<sup>45</sup>

#### **Hepburn Construction Under the 1940 Naval Appropriations Act**

The first appropriations to enact the Hepburn Program came with the passage of the 1940 Naval Appropriations Act in May 1939, just 1 month after the program's endorsement by Congress. This bill approved \$63 million for improvements at Pensacola, Norfolk, and Pearl Harbor, and the establishment of new bases at Jacksonville-Banana River, Tongue Point, Kaneohe Bay, Kodiak, Sitka, and four overseas locations. The appropriation also provided for the purchase of land at Quonset Point.

The most influential architectural aspect of this round of construction was the commissioning of two standard hangar plans that would dominate the Navy's air station construction program throughout the war, to a degree not seen in any other construction campaign. In mid-1939, the Albert Kahn architectural firm of Detroit, MI, was contracted to produce standard designs for both landplane and seaplane hangars. The results were the B-M Landplane Hangar and B-M Seaplane Hangar standard designs. The landplane hangar featured a single hangar bay measuring 200 x 200 ft, spanned by a steel flat-gabled truss at a clear height of 28 ft. The seaplane hangar plan featured identical architectural elements and style, differing from its counterpart only in its dimensions. It featured a large single hangar bay measuring 320 x 240 ft, spanned by the typical steel flat-gabled truss at a height of 38 ft (Figure 4-14). The standard plans are not spe-

cific about cladding and roofing, but it appears as though asbestos-protected metal cladding and roofing, or built-up tar roofing were the norms. Two distinctive sawtooth monitors top the rooflines on the vast majority of both these hangars, but other monitor schemes were used at some locations. For example, at least one model of the landplane hangar at Quonset Point exhibits a pronounced peak in the sawtooth monitors.

While the B-M designs appear to have originated with Kahn's firm, other firms derived their own designs from these standard plans. The Robert & Co. firm of Atlanta, GA, produced a number of such derivations, most commonly affecting the monitor scheme, but there is no indication that these derivations were ever employed. Examples of the B-M Landplane and Seaplane Hangars were constructed at the vast majority of the air stations that received new construction in the years leading up to and during WWII, including Norfolk, Pearl Harbor, Jacksonville, Corpus Christi, Quonset Point, Key West, Long Beach, Floyd Bennett Field, Kaneohe Bay, Barbers Point, Kodiak, and at least some of the old Naval Reserve Air Stations.<sup>46</sup>

It may be of interest that the first station to receive construction under the 1940 Naval Appropriations Act — NAS Pensacola — was one of the few that did not receive any of the standard B-M type hangars. Expansion began at Pensacola in 1939. It included the construction of two more landplane hangars and an aircraft storehouse at the main base field, and a seaplane hangar along the southern bulkhead in the seaplane operating area, as well as other nontechnical construction. All of this work was completed by the end of 1940. The two landplane hangars were constructed to complete the flight line that started with the 1937 hangars. They followed the same 1933 Bureau of Yards and Docks standard design used in the earlier hangars and those at Corry Field, featuring a single hangar bay measuring 110 x 160 ft, spanned by a steel flat-gabled truss at a clear height of 20 ft. The typical massive corner piers and substantial masonry construction were also quite evident. One of these structures (Hangar 630) also included a control tower, which was added atop the northwest corner pier to serve the new flight line (see Figure 3-28). The Aircraft Storehouse was constructed according to plans completed by Robert & Co. architects of Atlanta, GA. It followed the same architectural style as the land-plane hangars, with masonry construction, heavy corner piers, and distinctive copper flashing, but was built to a much larger scale. It, too, featured a single large hangar bay measuring 320 x 200 ft, spanned by a steel flat-gabled truss at a clear height of 30 ft, but this hangar was later lengthened by 100 ft (Figure 4-15). The seaplane hangar also exhibited the typical architectural style of its contemporaries, with substantial masonry construction, massive corner piers, copper flashing, and asbestos roof-

ing. It, too, featured a single large hangar bay (360 x 240 ft), spanned by a steel flat-gabled truss at a height of 58 ft (Figure 4-16).<sup>47</sup>

NAS Norfolk was identified in the Hepburn Program as the major air station for the central East Coast area, and was thus intended to support two carrier groups (expandable to four), four patrol squadrons (expandable to six), two utility squadrons, and engine and aircraft overhaul operations. Before the Hepburn program, most of the structures were of temporary-grade wartime construction dating back to WWI. A great deal of work was needed to bring the station up to its planned operational capacity. The first construction activities began in early 1940, including three new runways for the landplane field, three landplane hangars, two seaplane hangars, and other nontechnical construction. All five hangars were constructed according to the standard B-M Landplane Hangar and B-M Seaplane Hangar designs. By 1945, three more landplane hangars and a third seaplane hangar were added, and housing for more than 29,000 naval personnel was available.<sup>48</sup>

The air station on Ford Island at Pearl Harbor also received substantial improvement under the 1940 appropriation. Its development comprised a large part of the \$15 million Pacific Naval Air Base Contract awarded to a consortium of contractors in August 1939. This contract covered all the bases in Hawaii and Alaska as well as those on more remote Pacific islands such as Midway, Wake, Guam, and Johnston. Work began on Ford Island in November, as the Army finished vacating its facilities there in favor of the newly developed Hickam Field, and was completed before the Japanese surprise attack. The record is not clear on exactly what technical construction Pearl Harbor received, but it clearly included a number of hangars. Given the fact that Albert Kahn is listed in the naval contracts as the architect for the project, and considering how many other Pacific bases received standard B-M type hangars, it seems likely that Pearl Harbor's new development included some of these as well. However, based on records available at this point, the specifics cannot be determined with certainty.<sup>49</sup>

The first of the Navy's new air stations was established at Jacksonville – Banana River, FL. The Hepburn Program foresaw requirements for its Southeast air station to support two carrier groups (expandable to four), three patrol squadrons (expandable to six), two utility squadrons, and complete engine and aircraft overhaul facilities. The main base at Jacksonville was to be supported by a large auxiliary field at the Banana River site. Dredging and filling operations began in September 1939, and had progressed enough by the end of the year for contracts to be let for the first two of its 12 steel hangars. By December, dredging and filling had also begun at Banana River.

Actual construction began in January 1940 with the erection of three storehouses. By March, construction of some gas storage facilities and the first two hangars were under way. May brought the first barracks projects and the start of the Assembly and Repair Shop. In June, a contract was let with three construction firms for a total in excess of \$13 million for the completion of the base's aviation shore facilities. These included four standard B-M Landplane Hangars (Figure 4-17), three standard B-M Seaplane Hangars (Figure 4-18), and three 1/2 B-M Landplane Hangars. These latter structures followed Kahn's standard plan, but were cut along the longitudinal axis to provide a standard hangar bay width of 200 ft, but a depth of only 100 ft (Figure 4-19). In the same month, construction began at Banana River, including a single landplane hangar that was also probably constructed according to the B-M Landplane standard plan. The base was officially commissioned at noon on 15 October 1940, but it was not until the next day that the very first of its structures reached completion, and the first training class arrived in November of that year.

All the hangars in this first construction effort were finished during 1941, with the exception of the Assembly and Repair Shop. This was the only technical construction on the base for which Kahn was not the designated architect. Rather, the Robert & Co. architects received this contract in March 1940. This firm was, in fact, given the contracts for a number of these A&R facilities across the country, which probably explains their similarity. Like the 1937 Pensacola A&R Shop, this structure featured two very large hangar bays separated by an immense shops annex, allowing aircraft to enter through one hangar bay for disassembly, progress through its overhaul in the shops area, then be reassembled and exit through the other hangar bay. The current overall dimensions of the building are 1,860 x 800 x 103 ft, including the shops annex), but the dimensions of the original hangar bay begun in 1940 are 200 x 140 ft. The structure exhibits the familiar substantial masonry construction, massive corner piers, flat-gabled profile with large, peaked central monitor, and copper flashing that are common to the A&R shops at Pensacola, Kaneohe Bay, Quonset Point, Barbers Point, and Cherry Point (Figure 4-20). Sufficient evidence is not available to conclude that these structures were constructed from a standard plan, but they do appear to follow a common layout, with two large hangar bays separated by a low shops annex, and they do exhibit similar massing, architectural elements, and style. The Banana River A&R structure was finally completed only in 1945.<sup>50</sup>

The second new air station begun under the 1940 Naval Appropriations Act was at Tongue Point, OR, near the mouth of the Columbia River. This base was intended as an auxiliary to the major station at Seattle. Contracts were awarded in July 1940, and included one seaplane hangar. No details are available about this structure.<sup>51</sup>

The first of the new overseas bases approved under the FY40 appropriation was Kaneohe Bay, HI. This base was intended to serve as a second major air station in the Hawaiian Islands area to support expanding naval aviation activities in the Pacific. Its establishment was also a component of the 1939 Pacific Naval Air Base contract, but air field construction was delayed until summer 1940. The original construction campaign included five landplane hangars, two seaplane hangars, two “Midway-type” hangars, and a maintenance hangar. This last structure was originally constructed according to an Albert Kahn plan that featured a single small hangar bay measuring 160 x 120 ft with no exterior lean-tos. This original plan already provided for future expansion of the structure to a full 320 x 240 ft standard B-M Seaplane Hangar, and this expansion was executed in December 1941. Given that this hangar was certainly designed as a 1/4 B-M Seaplane Hangar and that Kahn was the contracted architect for the naval aviation facilities at Kaneohe Bay, it is almost certain that the five landplane hangars and the two seaplane hangars also conformed to the standard B-M designs. However, it is not at all clear exactly what the “Midway-type” hangars were. All of the structures received corrugated asbestos or asbestos-protected corrugated metal cladding and roof sheathing. Apparently, the original funding for this project fell somewhat short of the mark, as a second appropriation of \$800,000 was necessary in February 1941 to complete the job under the Fourth Supplemental National Defense Appropriations Act of 1941.<sup>52</sup>

The new air station at Kodiak, AK, actually comprised a major expansion of an existing Reserve Air Station. Construction began in 1939 under the Pacific Naval Air Base Contract although no hangars were included in the first year’s projects. Kodiak would eventually receive four hangars over the course of the war, including one permanent landplane hangar measuring 50 x 184 ft, one temporary landplane hangar measuring 112 x 163 ft, and two permanent seaplane hangars measuring 320 x 250 ft. Given the familiar dimensions of these latter hangars, and the fact that Albert Kahn is again listed as the contracted architect, it is very likely that these seaplane hangars were constructed according to the standard B-M Seaplane Hangar design, or were some sort of derivations. Moreover, other Bureau of Yards and Docks reports that refer to “Kodiak-type” hangars may in fact refer to this design. In addition, Kodiak received three semipermanent landplane hangars for the Army’s use from Fort Greely, and operated 11 outlying auxiliary facilities, none of which had hangars.<sup>53</sup>

The second new Alaskan air station was established at Sitka, again under the 1939 Pacific Naval Air Base Contract, costing about \$3 million. The project was eventually enlarged to approximately \$32 million by July 1942. The base was commissioned in September 1939, and while it is unclear when the hangars were actually constructed, they were certainly in operation by mid-1942. By that

time, Sitka had received two permanent seaplane hangars measuring 186 x 254 ft. No conclusive evidence is available concerning these hangars, but once again, given that Albert Kahn was the contracted architect and that the stated dimensions constitute a 1/2 B-M Seaplane Hangar, it is possible that these structures were based on the standard B-M plan. Sitka also operated six subsidiary stations, only one of which had a single temporary wood hangar.<sup>54</sup>

In addition to these new projects, three bases begun before the Naval Expansion Act of 1938 continued developing during 1939 and 1940. The naval air station at Seattle continued to expand as the Hepburn Program's Northwest major air station, slated to support one carrier group, three patrol squadrons (expandable to six), complete engine and aircraft overhaul operations, as well as additional service facilities for Alaskan squadrons. Over \$2 million in Work Projects Administration (WPA) and Public Works Administration (PWA) funding allowed the construction of two large landplane hangars and additions to some of the existing structures. While a number of hangar plans for Seattle exist in the Bureau of Yards and Docks cartographic collection, it is not currently known which of these designs were employed in the 1939 – 1940 construction program.<sup>55</sup>

The Hepburn Program's major air station on the central West Coast at Alameda also continued its development during this period. This facility was scheduled to support two carrier groups (expandable to four), five patrol squadrons, and complete engine and aircraft overhaul operations. The Navy had acquired Benton Field from the Army, and had expanded into some old Pan Am facilities at the Alameda Airport, including three existing hangars. New hangars and an aircraft storehouse were to be completed by the last quarter of 1940, but few details are available on the nature of these structures. A single photo in the Bureau of Yards and Docks report on World War II-era construction shows a distinctive A&R shop at Alameda featuring three large flat-gabled bays of substantial poured-concrete construction, but this building is not mentioned in the text (Figure 4-21).<sup>56</sup>

Finally, the operational air station at San Pedro continued its development by means of an \$850,000 appropriation from WPA and PWA sources for the completion of its technical construction, including three hangars. No details are available for these structures.<sup>57</sup>



### ***Expansion Under the 15,000-Plane Program***

#### **Ramping Up for National Emergency**

Most of the construction efforts related to the Hepburn Program were still in progress when the strategic assumptions on which that program was based were rendered obsolete by the outbreak of warfare in Europe. As Germany crashed through France, President Roosevelt began to shift the national defense establishment to a state of limited emergency. In May 1940 he delivered his 50,000-plane speech, advocating a combined air strength for the Army and Navy of 50,000 planes by 1945, and calling for a yearly production of that same amount by the nation's aircraft industry. On 14 May, Congress authorized an increase in the Navy's aircraft strength to 4,500 planes. The next day, the figure was bumped up to 10,000. With the fall of France in June 1940, Roosevelt initiated the Two-Ocean Navy Program, which increased the surface vessel strength by 70 percent and raised the aircraft complement to 15,000 planes. A portion of this expansion included an augmentation in the Marine Corps' aircraft strength to just under 1,000 planes. In addition, the Secretary of the Navy was authorized to expand the Navy's air arm as he saw fit to meet the demands of national security. In June 1940, still in the process of expanding for the 3,000-Plane Program, the Navy had 1,741 aircraft and just under 3,000 pilots. By December 1941 the aircraft inventory had risen to 5,260 planes. The Bureau of Aviation could field 6,750 pilots, supported by over 23,000 enlisted personnel and ground officers. Of course, the projected expansion to 15,000 aircraft would entail even greater growth in training, basing, and maintenance loads than had already been accomplished, and significant expansion of the aviation shore establishment was clearly necessary to support the 15,000-Plane Program.

#### **Construction Under the 1941 Naval Appropriations Act**

In the midst of this flurry of administrative activity, the Naval Appropriations Act for 1941 cleared committee in May 1940. It approved just over \$34 million for expansion of the Navy's shore installations, but only about \$8 million of this was intended for aviation facilities. Following Roosevelt's inauguration of the Emergency National Defense Program in June, however, Congress passed a second naval appropriation for 1941 that authorized over \$57 million in new air station projects. The bulk of this amount was intended for the expansion of the Bureau of Aeronautics aviation training facilities in Florida and Texas.<sup>58</sup>

At the time of the passage of the 1941 Naval Appropriations Act, Pensacola remained the Navy's only aviation training station. Given the increased pilot training loads that would be flooding the air establishment in the near future —

even before the 15,000-Plane Program — it was obvious that expansion here was crucial. Air traffic congestion at the main base made further expansion there impracticable, however, so the Navy established auxiliary training stations in the general vicinity. A \$4 million contract was let in July 1940 to help meet this need, resulting in some improvements at the main base and the establishment of a second auxiliary field to complement the one at Corry Field. Sauffley Field was established in late 1940, but received only a single landplane hangar costing \$150,000. Although no details are available on this structure, its low cost would tend to indicate a temporary structure of modest size. In early 1941, a third auxiliary field was established and designated Ellyson Field. This installation received two hangars of the type found at the main station and Corry Field, featuring a single 110 x 160 ft hangar bay, flat-gable profile, and heavy masonry corner piers.<sup>59</sup>

While these facilities would help accommodate the rising tide of aviation cadets, it was clear that more had to be done. Given the benign weather of the Gulf Coast and southeast areas, the Bureau of Aeronautics decided to concentrate their training operations there. The new naval air station at Jacksonville was thus redesignated as an intermediate training base, with oversight of other minor bases in south Florida. As part of this plan, Jacksonville received a fourth standard B-M Seaplane Hangar at a cost of \$450,000, which was completed in 1942. The Banana River auxiliary field also received two seaplane hangars, at a cost of \$400,000 each. It is uncertain whether these latter hangars were of the standard B-M Seaplane design.<sup>60</sup>

The most significant expansion project undertaken to accommodate the pilot training load was the establishment of a second primary training station at Corpus Christi, TX. This base was designed to duplicate the training capacity of the Pensacola facilities. It was located on the Gulf Coast to take advantage of the fine weather in that region, and also in order that it would be close enough to Pensacola to promote close coordination between the two.

Establishment of the training base met a series of obstacles in the planning and funding stage. First, a congressman from New Orleans vigorously protested that his district would be a better location for this activity. After successfully defending their site selection, naval officials were forced to go back to a hostile Naval Appropriations Subcommittee in order to secure additional funding when the first appropriation proved insufficient to complete the facility as planned. Specifically, an initial May 1940 appropriation of \$25 million in the Naval Appropriations Act of 1941 had to be followed by an additional \$15 million in February 1941 under the Fourth Supplementary National Defense Appropriations Act of 1941. Then, a further \$8.5 million was made available in July 1941 under the

First Supplementary National Defense Appropriations Act of 1942. Some members of the Naval Appropriations Subcommittee were less than pleased about these extra expenditures and took the opportunity to call into question every subsequent appropriation concerning the Corpus Christi base. Nevertheless, the Navy did get its appropriations, and the original contract was let on schedule in June 1940 to three separate companies.

The original construction contract called for the construction of four landplane hangars and four seaplane hangars, a reinforced concrete A&R Shop measuring 610 x 400 ft, and substantial housing facilities. Each of three auxiliary fields was also to receive four landplane hangars. Expansion to the original appropriation under the First Supplementary National Defense Appropriations Act of 1942 brought an additional three landplane hangars and one seaplane hangar to the main station, for a total of seven of the former and five of the latter. Both the landplane and seaplane hangars were constructed according to the standard B-M Landplane and Seaplane designs as executed by the Robert & Co. architectural firm. They were clad in concrete stucco, however, as opposed to the metal cladding of the Kahn standard design. No information is available on the A&R Shop, although with the Robert & Co. architects on the job, it is possible that it was similar to those at Pensacola or Jacksonville.

All of these structures were completed by early 1942, and most had been finished by early 1941.<sup>61</sup>

The final training base established under the 1940 Naval Appropriations Act was located at Miami, under the administrative umbrella of the Jacksonville facility. This base had already been operating as a Naval Reserve Air Station when the Navy occupied its two civilian air fields in June 1940 and let contracts for an expansion program. This program included three landplane hangars, runways, aprons, and other nontechnical construction projects. No design details are available about the hangars, but they were budgeted at \$225,000 each — the same amount designated for the B-M Landplane Hangars at Corpus Christi. Fiscal problems were met with here as well, and the Navy was forced to return to Congress for more funding in February 1941 under the Fourth Supplemental National Defense Appropriations Act of 1941, and again in July of that year under the First Supplementary National Defense Appropriations Act of 1942.<sup>62</sup>

#### **Construction Under Supplemental 1941 Defense Appropriations Acts**

Immediately after the passage of the initial FY41 Appropriations Act in June 1940, Congress passed the First, Second, and Third National Defense Appropri-

ations Acts of 1941 within the month. The first act provided over \$1.25 billion for the armed forces, of which over \$200 million was earmarked for the expansion of the Navy's shore establishment. Included in this amount were the funds required for the completion of all of the Hepburn Board's recommended projects, with the exception of three island bases in the central Pacific. These defense funds became available for expenditure on 1 July 1940, at the same time as the regular FY41 appropriations. The second and third acts were passed concurrently with the first, and provided some of the extra funding necessary to support the Two-Ocean Navy Program and the 15,000-Plane Program. Together, these acts appropriated a further \$100 million for base expansion, of which some \$17 million was intended for air stations. In February 1941 Congress passed the Fourth Supplemental National Defense Appropriations Act of 1941, the primary purpose of which was to provide funds for many of the new bases acquired from the British in the Atlantic and Caribbean under the Lend-Lease Act. It also included over \$57 million for further expansion at developing air stations and for the completion of outstanding contracts for which the original appropriations had run short. In fact, the bulk of the funding provided by this fourth act was for this latter purpose, so relatively few new contracts were let as a result of its passage. With the passage of the Fifth Supplemental National Defense Appropriations Act of 1941, which included no provisions for new aviation facilities, the total amount of defense funding approved by Congress in FY41 for the development of the Navy's shore installations came to over \$600 million. Additionally, an extra \$400 million had been appropriated from other funding sources for the same purpose. By the end of the year, great strides were being made to prepare the Navy for the coming crisis.<sup>63</sup>

The First Supplemental National Defense Appropriations Act included funds for the expansion of three existing air stations to their maximum capacity. Norfolk received three additional standard B-M Landplane Hangars and one standard B-M Seaplane Hangar to complement the five hangars already under construction with FY40 funds. Alameda received two additional seaplane hangars, each measuring 242 x 320 ft. These dimensions may indicate that a version of the standard B-M Seaplane design was employed, but such an assumption should not be automatic here in light of the fact that Alameda had already received some demonstrably idiosyncratic construction in the form of its 1940 A&R Shop (see Figure 4-21). Finally, San Diego received one new seaplane hangar and two new landplane hangars in order to support its planned operational load of four carrier groups, one Marine Air Group, five patrol squadrons, two utility squadrons, and complete engine and aircraft overhaul operations. The total cost for the San Diego projects was \$3.666 million. Little is known about the landplane hangars except that they featured steel truss construction with a flat-gable profile, and were clad with a combination of metal and concrete stucco materials.

The concrete seaplane hangar appears to have been constructed according to a March 1940 plan provided by the Roberts and Shaeffer Company of Chicago, IL. This double hangar featured two large pull-through bays, each measuring 224 x 254 ft, spanned by a substantial monolithic concrete open arch at a peak height of 82 ft. One distinctive feature of this structure lies in the series of ten arches on each bay, which are actually exterior to the roof cladding. Due to the shallow angle by which the arch meets the ground, the overall size of this immense structure is substantially larger than the usable space within the hangar bays would indicate, with the total width exceeding 600 ft (Figure 4-22). All of the contracts at these three bases were let in July 1940, and most were completed by the end of 1941.<sup>64</sup>

The First Supplemental National Defense Appropriations Act of 1941 also included funds for the establishment of the last of the major air stations identified in the Hepburn Base Program. The base at Quonset Point, RI, was to provide facilities for two carrier groups, two patrol squadrons (expandable to four), and complete engine and aircraft overhaul operations. A contract was let in July 1940 to two construction companies for a total of just over \$24 million. This contract included the construction of four landplane hangars, two seaplane hangars, and an A&R Shop, along with other technical and nontechnical construction, as well as 20 million cu yd of dredging. Albert Kahn is listed as the contracted architect, and it appears as though the hangars were constructed according to a derivation of the B-M Landplane and B-M Seaplane standard hangars.

The Quonset Point hangars feature a distinctive peak in the standard twin sawtooth monitors (Figure 4-23). Little is known about the A&R Shop, but a photo in the Bureau of Yards and Docks report shows the familiar tall, flat-gable profile, topped by a gabled central monitor, substantial masonry corner piers, and shops annexes that mark similar facilities designed by Robert & Co. for Pensacola and Jacksonville (Figure 4-24).<sup>65</sup>

A new air station was also established at Dutch Harbor, AK, under the First Supplemental National Defense Appropriations Act of 1941. This project was appended to the 1939 Kodiak and Sitka contracts in July 1940. Work began immediately but was suspended after the Japanese bombed the site in June 1942. It was finally completed by the Seabees by November 1943. Dutch Harbor received two hangars, including one permanent “blast-pen-type” hangar, and one semipermanent Kodiak-type. It also had three outlying landing fields including Otter Point, which received one 160 x 190 ft Kodiak-type hangar. Once again, Albert Kahn is listed as the contracted architect, and it is possible that the Kodiak-type hangars were based on half of the standard B-M Seaplane Hangar design, as was likely done at Kodiak and Sitka. The odd width of the Otter Point

hangar probably includes lean-tos, as this is the general practice in the Bureau of Yards and Docks report. Perhaps some confirmation might be seen in the fact that Dutch Harbor later received funds under the Fourth Supplemental National Defense Appropriations Act of 1941 (February 1941) and the First Supplemental National Defense Appropriations Act of 1942 (July 1941) to extend these hangars, indicating that they were probably erected as partial structures to begin with. There is no indication of what the “blast-pen-type” hangar may have been.<sup>66</sup>

The final set of improvements funded under the First Supplemental National Defense Appropriations Act of 1941 was the expansion of the 11 old Reserve Air Stations and the establishment of three new ones in order to enable them to support a primary flight training mission. With the 15,000-Plane Program coming into effect, the pilot training load was growing beyond the capacity of even the newly expanded training facilities in Florida and Texas to accommodate. Therefore, the Bureau of Aeronautics decided to shift all of its primary flight training to the old and new Reserve Air Stations in order that the Training Stations could concentrate on intermediate flight training. All eleven of the old reserve stations received some improvement, consisting primarily of nontechnical construction to provide adequate quartering for the expanded training classes. In addition, four of the old bases — Minneapolis, Grosse Isle, St. Louis, and Oakland — as well as the three new stations at New Orleans, Dallas, and Atlanta each received a single hangar. Each hangar project was funded at between \$320,000 – \$360,000 for the construction of a modified B-M Landplane Hangar. The standard plan was amended to include a control tower on one of the corners, and a rifle range and classrooms were provided in substantial lean-tos along each side (Figure 4-25). The St. Louis station also appears to have received an A&R Shop, but no details are available. The total cost of these expansion projects was \$10 million.<sup>67</sup>

The Marine Corps also received improvements in its aviation shore establishment under the First Supplemental National Defense Appropriations Act of 1941, with expansion at the Quantico and Parris Island Marine Corps Air Stations. A \$1.46 million July 1940 contract was let for expansion at Quantico, which appears to have included two hangars of an undetermined type. The current dimensions of one of these structures are listed as 254 x 194 x 45 ft, but no dimensions are available for the other structure. Both feature steel truss construction of a closed, flat-gable cross section, and both have metal cladding. At Parris Island a new two-story landplane hangar measuring 130 x 210 ft was begun in October 1940. No other details are available. While the expansion of Marine Corps facilities was minor at this time, more substantial projects lay not far in the future.<sup>68</sup>

While most of the funding approved under the Fourth Supplemental National Defense Appropriations Act of 1941 went to the completion of works in progress, two new contracts were let in May 1941, just as the FY42 appropriations were being voted out by Congress. The first was for the construction of a single land-plane hangar at Anacostia for \$300,000. No details are available on this project. The second was for the construction of Kodiak's first seaplane hangar for a sum of \$800,000. This appears to have been the first of the four hangars erected at that installation. Based on the fact that Albert Kahn was the contracting architect, and that the hangar featured the familiar dimensions of 320 x 250 ft, it is quite likely that this hangar was constructed according to the standard B-M Seaplane Hangar design, or some derivation of it. Moreover, it is possible that this is the "Kodiak-type" hangar referred to in later Bureau of Yards and Docks reports on other Alaskan construction projects.<sup>69</sup>

#### **Construction Under the Naval Appropriations Act of 1942**

This bill passed Congress in May 1941, carrying the approval for over \$132 million in new construction projects. Of this sum, over half was intended for the continued expansion of existing air stations to accommodate the needs of the 15,000-Plane Program. None of these new funds were allotted for establishing new bases. The entire amount was intended for the completion of contracts already underway, and the letting of a number of new contracts to provide necessary facilities at established air stations. Most of these new contracts, in fact, were awarded for projects at Pacific air bases in Hawaii and Alaska.<sup>70</sup>

In Hawaii, Pearl Harbor was slated to receive an extension to the Aircraft Overhaul Building at \$675,000 and the Assembly Building at \$500,000. No details are available on either of these projects. Kaneohe Bay secured \$773,000 for the construction of its third standard B-M Seaplane Hangar. The original two were currently under construction, and this contract was to provide the third in order to round out the shore establishment for the support of three patrol squadrons. In Alaska, the Kodiak air station received \$200,000 for the extension of a utility hangar and \$900,000 for the construction of its second seaplane hangar, identical to the first one constructed under the May 1941 contract. Again, it is likely that this was modeled on Albert Kahn's standard B-M Seaplane Hangar design. There is also some indication in the Congressional hearings that Sitka was to receive an additional seaplane hangar for \$500,000, but it is possible that this item was stricken from the bill prior to its passage.<sup>71</sup>

### **The Greenslade Board and FY41 Supplementary Funding**

A panel known as the Greenslade Board had convened in September 1940 to study the overall naval shore establishment and project its future development in light of the 2-Ocean Navy Program and the 15,000-Plane Program. It reported out to Congress in May 1941, just after the regular FY41 appropriations had cleared. Like the Hepburn Board, this second body expressed its program in terms of the planned capacities of each respective installation, and also like its predecessor, it found the Navy's aviation shore establishment wanting in light of recent expansion of the air arm. The Second Deficiency Appropriations Act of 1942 passed Congress in July 1941 without having materially addressed the Greenslade Board's recommendations. Congress approved approximately \$50 million in construction projects, about \$30 million of which was for aviation facilities. About half that amount was intended for the establishment of a new Marine Corps Air Station at Cherry Point, NC. In addition, just under \$16 million was appropriated for the establishment of a network of lighter-than-air (LTA) fields around the East and West coasts.

Substantial appropriations for the expansion programs advocated by the Greenslade Board came with the August 1941 passage of the First Supplemental National Defense Appropriations Act of 1942. This bill approved some \$7 billion for the armed forces. The Navy was to receive \$1.65 billion, about \$83 million of which was earmarked for improvements to aviation shore facilities. The two largest items here were the establishment of two new air stations at Whidbey Island, WA, for \$3.8 million, and Barbers Point, HI, for \$18 million. Other significant expansion programs were also funded for the construction of new facilities and the establishment of new auxiliary fields at a number of existing bases.

Construction began at the new Cherry Point station in June 1941 under a \$15 million contract funded by the Second Deficiency Appropriations Act of 1942. This station was situated near Camp Lejeune to facilitate coordination of close air support training for the recruits there. The original construction program featured two landplane hangars of about 90,000 sq ft each, with steel-frame construction and asbestos-protected steel siding. Cherry Point also received an A&R Shop that was completed in April 1942. This structure appears to be similar in style to those at Jacksonville and Quonset Point, with the typical flat-gabled profile topped with a peaked central monitor, massive masonry corner piers, and copper flashing (Figure 4-26).<sup>72</sup>

The Second Deficiency Appropriations Act also provided for the establishment of a network of LTA fields that the Navy had planned in 1940. This plan was expanded in 1942 to include the only existing LTA field at Lakehurst, NJ, plus



eight new fields: South Weymouth, MA; Weeksville, NC; Richmond, FL; Santa Ana, CA; Hitchcock, TX; Houma, LA; Glynco, GA; and Tillamook, OR. Finally, the Navy's old facilities at Moffett Field were to be reoccupied and expanded. The first construction under this program actually began at Lakehurst in June 1941, just before the passage of the Second Deficiency Appropriations Act of 1942. This work included the erection of two new steel LTA hangars, one 614 x 217 x 118 ft and the other measuring 414 x 217 x 118 ft. Both hangars were constructed of immense steel truss arches and feature massive, squared-off steel-framed pockets for the sliding door at the north end (Figure 4-27). The larger of the two LTA hangars was completed in May 1942, joined by the smaller model in June of that year. In September and October 1941, work began at the new LTA stations at South Weymouth and Weeksville, respectively. Each received a single steel-framed hangar measuring 960 x 328 x 190 ft. Construction on the remainder of the LTA network had not yet begun before the U.S. entered the war in December 1941.<sup>73</sup>

The First Supplemental National Defense Appropriations Act of 1942 provided most of the funds necessary to finance the completion of facilities advocated by the Greenslade Board. Construction began at Whidbey Island, WA, and Barbers Point, HI — the last two operational air stations established before U.S. entry into the war. Whidbey Island was established as a second operational base in the Puget Sound area, at a cost of \$3.79 million. Originally intended as an adjunct to the existing Seattle facilities, it was designed to accommodate two patrol squadrons (expandable to four) and one in-shore patrol squadron. Due to congestion at Seattle, however, it soon became the primary operating base in the Pacific Northwest. As originally developed in 1941, the base received only the barest minimum of facilities, including a single seaplane hangar costing \$700,000. This structure featured a single hangar bay measuring 250 x 200 ft, spanned by a steel flat-gabled truss at a peak height of 47 ft, and clad in corrugated steel. Sometime during 1941 Whidbey Island also received a single landplane hangar constructed according to the standard Army Type OBH-2 Hangar, featuring a wood bow-string truss. Whether this structure was already under construction by the Army when the Navy occupied the site, or whether it was constructed later by the Navy, is unclear.<sup>74</sup>

Arrangements for establishing the Barbers Point air station were appended to the Pacific Naval Air Base Contract in fall 1941. Actual construction did not begin until November of that year, so it had not progressed much before the Pearl Harbor attack. The station was originally designed for a capacity of two carrier groups, and was intended as an adjunct to Pearl Harbor. After U.S. entry into the war, however, Barbers Point was developed as an independent operational air station for four carrier groups. The original \$18 million appropriation antici-

pated the construction of four hangars at \$400,000 each, and an A&R Shop at \$1.2 million. Only two of the hangars were built in the first construction campaign, however, and funds for the other two had to be acquired under the Naval Appropriations Act of 1943. The hangars featured steel-frame construction and measured 370 x 240 ft. Given these dimensions and the prevalence of the B-M standard designs in the Pacific Naval Air Base contracts, it is possible that these structures were also based on the B-M Seaplane Hangar plan. The A&R Shop exhibits the typical architectural elements and style of similar structures at Jacksonville, Quonset Point, and Cherry Point, with the familiar massive corner piers, flat-gabled profile with peaked central monitor, and copper flashing (Figure 4-28).<sup>75</sup>

A fair amount of expansion at existing facilities was also executed in the summer and fall of 1941 under the First Supplemental National Defense Appropriations Bill for 1942. Corpus Christi received funding for the three B-M Landplane Hangars and one B-M Seaplane Hangar previously described, totaling about \$1.6 million. Tongue Point received an additional hangar of an undetermined type for \$450,000. Sitka received a single seaplane hangar at a cost of \$1 million. Kodiak received its two landplane hangars — one permanent hangar measuring 50 x 184 ft for \$500,000 and one temporary hangar measuring 112 x 163 ft for \$140,000. No design details are available for any of these Alaskan projects. In addition, the training base at Jacksonville received a second standard B-M Landplane Hangar at its auxiliary Lee Field at a cost of \$360,000. In July 1941, work began on a third auxiliary filed for Jacksonville, designed to match facilities at the newly expanded Lee Field. Commissioned Cecil Field in December 1941, this installation also received two standard B-M Landplane Hangars, at a cost of \$360,000 each.<sup>76</sup> These projects marked the last expansion foreseen by the Navy for FY42, but further development was still anticipated to meet the needs of its growing air strength.

When naval officials again appeared before Congress to request funding for this type of activity, the country was in a state of war and new conditions were shaping events. By the time FY43 appropriations were before Congress, the Navy's authorized air strength had already been almost doubled to the figure of 27,500, and the exigencies of war demanded that the government relinquish direct oversight of military expansion. While much had been done over the preceding years to prepare the Navy for the coming war, much had yet to be done to ensure victory at sea.

### ***Wartime Construction***

The Japanese attack on Pearl Harbor on 7 December 1941 dealt the Pacific Fleet a crushing blow and brought the U.S. abruptly into the rising global conflict. The Navy would play an important role in the European theater of conflict, most importantly by winning control of the Atlantic by 1943 against a potent German U-boat menace, and by supporting the massive invasions of the European mainland in 1943 and 1944. Nevertheless, the war against Japan that spanned the Pacific Ocean would certainly dominate the Navy's attention and most directly shape its development. It was, in fact, the war for which the Navy and the Marine Corps had been preparing over the previous decades. It was a conflict in which naval power — especially naval air power — and amphibious assault operations played the decisive role. In the vast expanses of the Pacific, the possession of strategic island bases and the actions of carrier task forces would shape the course of the war. The massed might of the Army and Army Air Forces would play important roles in the South and Southwest Pacific, where land masses were more closely spaced, but even there the Navy and Marine Corps could be the deciding factor. In the Central Pacific, however, the immense distances between isolated island chains meant that the only air power available to support attacking U.S. Marines was that based on Navy carriers. Here, then, was where the Navy fought its war and where naval aviation played its most decisive role.

### **The Navy's War**

Pearl Harbor had left the Pacific Fleet crippled, stripped of most of its fighting capacity except for the three major carriers that had been out to sea when the Japanese planes dove from the clouds. By necessity, then, the Navy confined itself to a series of delaying and harassing actions launched from these vessels during the first days of the Pacific war as the Japanese advanced across the Pacific basin in a lightning offensive.

Carrier actions in the Doolittle Raid and the Battle of the Coral Sea dominated the first 6 months of the war, during which time Navy pilots flew the relatively inferior aircraft that were already in service at the beginning of the war. These included the Brewster F2A Buffalo and the Grumman F4F Wildcat fighters, the SBD Dauntless dive bomber, and the TBD Devastator torpedo bomber. This early phase culminated in the U.S. victory at the Battle of Midway in June 1942, where the tide of Japanese victories was stemmed for the first time. The Allied counter-offensive in the South Pacific began in August with Marine landings on Tulagi and Guadalcanal, opening stiff fighting for the latter island that would continue for 6 months. At the same time, the Japanese push to conquer New

Guinea was effectively turned back, ending the immediate threat to Australia by depriving Japan of air bases on the southern half of the island.

Over the course of 1943, the Army and Navy brought the Solomons campaign to a successful completion and made great strides toward completely ridding New Guinea of its Japanese invaders. By November, the Navy's Central Pacific campaign had swung into action with the seizure of the Gilbert Islands following victories at Tarawa and Makin. Here, the Navy relied on its growing fleet of aircraft carriers — both the immense Essex-class vessels and the smaller carrier vessel escorts (CVEs) — to provide the air power necessary to seize air superiority from Japanese land-based aircraft and provide floating bases from which Marine Corps and Navy pilots could conduct their devastating close air support missions on behalf of the assaulting ground forces. Also, superior new aircraft that had been on the drawing boards in December 1941 were entering the inventory during 1943. These included the F6F Hellcat, the SB2C Helldiver, and the TBF Avenger, as well as the Marines' F4U Corsair.

During 1944, the Central Pacific campaign proceeded apace, with the Marshall Islands falling to the Marines after fighting on Kwajalein and Eniwetok in February. Air assaults on other Japanese bases in the Central Pacific followed immediately thereafter, including attacks on Truk, Guam, Saipan, and Tinian. South Pacific operations in New Guinea were completed in April. The Navy then returned to the Central Pacific to seize the Marianas Islands after victory on Saipan, followed by the seizure of Guam in June. These islands were quickly turned into large airbases for the Army's B-29 Superfortresses, which began a devastating bombing campaign against the Japanese home islands. Moreover, the bulk of Japan's surface strength and naval air power was destroyed in the Battle of the Philippine Sea and the "Great Marianas Turkey Shoot," perhaps the finest day of combat in the history of U.S. naval aviation. Morotai and Pelau followed in September, and the reconquest of the Philippines commenced at Leyte in October. The hard-fought Battle of Leyte Gulf resulted in the destruction of most of the remainder of the Imperial Japanese Fleet, laying the way for an advance against the Japanese home islands.

In January 1945 U.S. troops invaded Luzon in the Philippines, and fighting in the Southwest Pacific was largely over by February. Also in that month, the Marines seized Iwo Jima in order to secure the bomber routes to Japan and provide an advanced base from which to stage Air Force fighter escorts. April brought the invasion of Okinawa, and its final capture in late June — after 2 months of bloody land fighting and costly kamikaze attacks — eliminated the last impediment to the invasion of the home islands. The dropping of the two atomic bombs

on Hiroshima and Nagasaki in August 1945 brought the crippling B-29 strategic air offensive to a close, and Japan officially capitulated on 2 September 1945.

While the Army and Army Air Forces played crucial roles in bringing this victory — especially in the South and Southwest Pacific campaigns, and in the strategic bomber offensive against the home islands — the Navy undoubtedly played the key role in the war against Japan. This was most clearly demonstrated in the destruction of the Imperial Japanese Navy in a series of carrier battles, and in the decisive Central Pacific campaign wherein naval air power was the only air power on which the U.S. could rely for its assaults on Japanese-held island bases. None of this success would have been possible without an immense rise in the quality and numbers of the Navy's aircraft and aircraft carriers. The Navy began the war with only eight aircraft carriers and about 5,000 aircraft. By mid-1943, just before the start of the Central Pacific campaign, it operated 12 large aircraft carriers — including the first of the huge Essex-class vessels — and 17 escort carriers, with 16 more due off the ways by the end of the year. The number of aircraft in service had risen to over 16,000. By the end of 1944, 25 major carriers and 65 escort carriers had come to dominate the seas, operating more than 36,000 aircraft. By the end of the war, these figures had risen to 28 large carriers, 71 escort carriers (as well as dozens of the even smaller "jeep" carriers used for ferrying aircraft across the Pacific), and more than 41,000 aircraft. The number of pilots in service had risen from a total of 6,750 in the Navy, Coast Guard, and Marine Corps to more than 60,000, and the number of the support personnel had risen from about 21,000 to almost 345,000. As always, this sort of exponential growth required drastically expanded basing facilities, both for training and operations. Much had been done to provide these facilities in the years before Pearl Harbor, but still more needed to be done.<sup>77</sup>

#### **Wartime Budgeting and Construction at the Close of FY42**

Immediately following the Pearl Harbor attack, Congress passed the Second and Third Supplemental National Defense Appropriations Acts of 1942. The latter of these acts cleared Congress on 17 December 1941, just 10 days after Pearl Harbor. It included little in the way of specific appropriations for expansion of the Navy's shore installations. Funding for this purpose was limited to the establishment of one new air station at Floyd Bennett Field on Long Island, NY. On the other hand, the Third Supplemental Act also authorized a lump sum of \$300 million in funds that were not obligated to any specific project. The Secretary of the Navy was free to distribute these monies at his discretion to meet emergency needs as they arose. This lump sum appropriation was a drastic departure from normal funding procedures for the purpose of meeting the emergency needs of wartime. It was immediately clear to Congress that the exigencies of war dic-

tated that the service branches required much more flexibility to meet unexpected crises and prosecute the war efficiently. Consequently, the regular budgetary system was suspended for the time being. The Navy Bureau of the Budget suspended its regular function of receiving funding requests from the various bureaus, paring them down to acceptable levels, and submitting them to Congress. Instead, it concentrated on prioritizing all the Navy's financial requirements and granting as many of them as possible. When in doubt, the good of the warfighter was always placed before thrift. Not until relatively late in the war did the Navy Bureau of the Budget and Congress again get involved in examining naval funding requests and limiting or completely denying them.<sup>78</sup>

The new air station on Long Island, established at Floyd Bennett Field, an old Naval Reserve Air Station, was intended to support six patrol squadrons, one in-shore patrol squadron, and two carrier groups. There were already four hangars on the site, which had also served as a commercial airport for New York City. Construction was begun in mid-December 1941 on a standard B-M Seaplane Hangar.<sup>79</sup>

#### **The 1942 Wartime Construction Campaign**

The Naval Appropriations Act of 1943 passed Congress in February 1942, providing \$78 million for the liquidation of all outstanding construction contracts and another \$450 million lump sum appropriation for emergency projects. In addition, a further \$500 million was approved for contract authorization to be executed as the need arose. All of these funds were made available immediately, without waiting for the standard dispersal date of 1 July when the fiscal year officially started. The Fourth, Fifth, and Sixth Supplemental National Defense Appropriations Acts of 1942 were all passed by April 1942. The Sixth included an appropriation of \$800 million for naval construction projects, including the establishment of a number of new training and operational fields and the expansion of existing installations. The Contract Authorization Act of 6 August 1942 approved almost \$400 million for airbase construction in the U.S., Alaska, and Hawaii, and streamlined the appropriations process by relieving the Navy of the need to secure approval from both the Naval Affairs Committees and the Appropriations Committees of each house of Congress. In this case, the Navy had only to secure the consent of the House and Senate Naval Affairs Committees before entering into the necessary contracts. This arrangement was an extraordinary measure, however, and was not often repeated. This act allowed for the establishment of seven new air stations in the U.S. plus more in Alaska and Hawaii, as well as two new primary training fields in the Midwest, a glider base at a location to be determined later, and four new LTA stations.

Additional funding for 1942 construction projects was provided in the Supplemental Naval Appropriations Act of 1943, which passed Congress in March 1943. This bill approved approximately \$1.5 billion for public works, most of which went toward the liquidation of obligations incurred on projects already in progress. The vast majority of these projects were at overseas bases, however, and little went to projects in the U.S. In total, these appropriations provided over \$1 billion worth of new construction efforts in the United States, Alaska, and Hawaii, and an even greater amount for overseas bases. Little detail as to where these funds were allocated is available from the hearing transcripts, however, as naval officials were given a great deal of leeway in allocating resources as they saw fit in order to meet unforeseen requirements as they arose.<sup>80</sup>

The Navy rushed to launch its wartime construction effort. As the Bureau of Aeronautics training load expanded, so too did its network of training bases, with significant expansion at a great number of existing stations and the establishment of a number of new stations. Four new operational stations were also established in an attempt to relieve congestion at some of the major air stations, and five other installations received new auxiliary fields. Two new developmental air stations were also established to provide dedicated facilities for the Navy's experimental work related to new aircraft and new weapons. The existing LTA network received continued expansion as well. Finally, the Marine Corps received six new air stations in order to train, organize, and equip its rapidly expanding air arm. Few architectural details are available for any of these programs.

The start of the war brought an immediate increase in the Navy's authorized aircraft strength to 27,500 planes, of which about 20 percent were earmarked for the Marine Corps. Of course, this expansion also brought drastically increased training loads and necessitated a great expansion of the Navy's aviation training system. The shortage of training facilities, perhaps more than any other problem, was viewed as the most crucial deficiency in the Navy's aviation shore establishment. Without well trained pilots, no amount of new planes and aircraft carriers could bring victory.

In order to accommodate this expansion, the old reserve bases — many of which had just recently been expanded for primary flight training — were further expanded to allow for larger classes. Pensacola and Corpus Christi limited their activities to intermediate flight training of those cadets that had made it through primary training at inland bases. Jacksonville and its South Florida subsidiaries then accepted these pilots for operational training. Even with this expansion, however, a number of new bases had to be established in order to meet the

Navy's demand for pilots. Expansion at the old reserve bases was limited to housing facilities, so construction there mainly consisted of new barracks.

Seven new training bases were established in South Florida to operate under the oversight of the Jacksonville station. Each of these was set up on the site of an old municipal field, and each received only a single temporary wood hangar, some other supporting technical construction, and some barracks. A more substantial operation was begun at Key West, where the Navy assumed joint occupancy of the Boca Chica Field with the Army. A standard B-M Seaplane Hangar had actually been erected there in 1940 although there is no record of Navy use from that date.

Two new training bases were established on the West Coast at Los Alamitos and Long Beach, with each receiving a single hangar. The latter location had been a trouble spot for the Navy since the previous year. It had been one of the old reserve bases slated for expansion with the rest of that network but its location was poor, with little land available for expansion and prohibitive air traffic congestion from a nearby municipal airport. Consequently, this new base was established at an entirely new location, and received a single standard B-M Landplane Hangar — the same hangar facilities that the other old reserve bases had received in the expansion program.

Between February and July, six new training stations were established at inland locations to augment the old reserve bases in primary flight training. These new bases were Olathe, KS; Hutchinson, KS; Bunker Hill, IN; Memphis, TN; Norman, OK; and Ottumwa, IA.\* Olathe received a single temporary wood hangar, and the Bunker Hill station received two of the same. The other four sites each received two of what are described as “temporary” hangars, but a photo of the Memphis air station clearly shows two of the standard B-M types (Figure 4-29). It is worth noting at this point that one of the representatives on the Naval Appropriations subcommittee had chided a representative of the Bureau of Yards and Docks because his organization considered regular steel hangars to be “temporary” if the steel structural components were bolted together rather than welded. It may be that these “temporary” structures are, in fact, standard B-M

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\* In 1944, as wartime Navy construction was ramping down, Bunker Hill, Memphis, Norman, and Ottumwa were further expanded, and a fifth training station was constructed at Peru, IN, to accommodate intermediate flight training. These projects were considered necessary because most of the Navy's new trainees had progressed to the intermediate level and the demand for primary training had fallen off.



types that were simply bolted together in order to conform to the letter of the law concerning the preference for temporary construction during the wartime emergency. On the other hand, hangars had always been exempt from this general policy due to engineering concerns, so it is not clear from the available record why these hangars would have been termed “temporary.” Nevertheless, at least the two hangars at Memphis were constructed according to one of the standard B-M designs.<sup>81</sup>

Three new operational air stations were established in October 1942, at Brunswick, ME; Atlantic City, NJ; and Beaufort, SC. Brunswick received three wooden hangars and Atlantic City received two. Beaufort received only four nose hangars at first, with a full hangar added at some later date. No other details are available on these structures, but clearly the facilities on these new operational air stations do not compare in terms of capacity, quality, and intended duration of use with those on bases established at earlier dates.

A fourth new operational station had been established at Adak, AK, in August 1942, but work did not begin on the air field facilities themselves until January 1943. This island had been retaken from the Japanese in August, and the Seabees went to work to establish a much-needed operational base for the outer Aleutian Islands. Adak eventually received five Kodiak-type landplane hangars and three seaplane hangars of an undetermined type. This station also operated six outlying auxiliary fields, two of which had temporary wooden nose docks.<sup>82</sup>

In addition to these new fields, some established air stations also received new auxiliary fields. In April, Pensacola and Corpus Christi received new outlying fields, with Pensacola activating facilities at Barin and Bronson Fields. Barin received three temporary wood hangars, and Bronson received a single seaplane hangar and two landplane hangars; no details are available for these structures, however. Corpus Christi activated a new auxiliary field at Kingsville, receiving a single hangar measuring 234 x 170 x 69 ft. Again, no more detail about this structure is available. Five auxiliaries of the Norfolk air station received new barracks in May 1942, and four entirely new auxiliaries were established by November of that year. These new auxiliaries — Harvey Point, Manteo, Franklin, and Breezy Point — each received a single temporary wood hangar costing \$100,000. The main station at Norfolk also received the last of its standard B-M Landplane Hangars at a cost of \$300,000. Quonset Point received two new auxiliaries at Martha's Vineyard and Charlestown, each of which included a single temporary wood hangar, and the main base received a paint hangar at the cost of \$450,000. Finally, the air station at Alameda was supposed to have received some expansion at this time, but there is no indication of its nature.<sup>83</sup>

The two new developmental air stations were established at Patuxent River, MD, and Clinton, OK. Patuxent River received a good deal of technical construction, including 6 two-bay hangars featuring 160 ft reinforced concrete closed arches (Figure 4-30). Clinton received three timber hangars measuring 200 x 240 ft. No other details are available.<sup>84</sup>

Construction on the remainder of the Navy's LTA network also began in the spring of 1942. The stations at Richmond and Santa Ana each began construction in April, receiving a single LTA hangar of a new Bureau of Yards and Docks standard design. This plan featured an immense arched structure of timber construction, as wartime conditions dictated that steel be conserved as much as possible. The new hangar plan called for a single bay measuring 1,058 x 297 x 183 ft, designed to house six nonrigid airships. The new stations at Hitchcock, Houma, and Tillamook also received one of these hangars; construction began in the summer of 1942. No sooner had these efforts begun than the Navy launched a program to double the hangar capacity at each of its LTA stations. Between September and November of 1942, construction of the new timber LTA hangars was begun at all eight LTA stations around the country. Finally, in early 1943, the last augmentation to the LTA network began, with Moffett Field, Richmond, and Lakehurst all receiving a second timber hangar of the new design. Lakehurst's two examples of this timber LTA hangar are the last standing examples of their type (Figure 4-31). No more LTA construction was executed for the duration of the war because, by the time these facilities had reached completion in late 1943, the U-boat threat against which the airships were to be used was already receding.<sup>85</sup>

Finally, in 1942, the Marine Corps received six new air stations to allow for the training and organization of its Marine Air Groups before they rotated out to the Pacific theater. All but one of these facilities were located on the West Coast in California, with Eagle Mountain Lake, TX, being the exception. The new station at El Toro was established in April 1942 to support two complete Marine Air Groups, and thus had all of its facilities laid out in two symmetrical developments with identical structures for each group. In the original construction program El Toro received two wood-frame hangars, but by the end of the war it had a total of 17. Undoubtedly, El Toro was the primary Marine Corps Air Station on the West Coast. The El Centro and Mojave stations were established on the sites of the old Imperial and Kern county airports, respectively. Each was designed to support a single Marine Air Group, and each received one wood-frame hangar. The Santa Barbara air station was established on the site of the old Goleta airport, and appears to have received only a temporary wood-frame repair shop, with no full-size hangar facilities at all. The Edenton and Eagle Mountain Lake facilities were initially established in the summer of 1942 as amphibious glider

training bases, but as the Marines abandoned this endeavor early on, neither ever saw use in that capacity. Both were converted to regular training and organizational duties before commissioning. Edenton received a single masonry and wood-frame hangar, and Eagle Mountain Lake appears to have received no hangars at all, although an auxiliary field did receive a single nose dock to support seaplane training.<sup>86</sup>

### Construction in 1943

The Naval Appropriations Act of 1944 passed Congress in June 1943, approving about \$1.9 billion for construction projects. However, about half of that amount was intended for the liquidation of outstanding contracts already in progress, and all but about \$280 million of the remainder was for overseas projects. About \$75 million in new contract authorizations was approved, but it is clear that most naval appropriations subcommittee members felt that the bulk of the construction effort had already been completed. The Navy's representatives were even cautioned against acquiring too much real property that would simply have to be liquidated at the close of hostilities. Despite these congressional sentiments, the Contract Authorization Act of 28 January 1944 secured an additional \$281 million for public works, of which some \$50 million was intended for the expansion of naval aviation facilities. At this time, naval officials continued to protest that the naval aviation training load was still expanding as the largest class of cadets moved through the system, and that intermediate training facilities had still to be expanded. Once again, the Secretary of the Navy was granted the authority to enter directly into contracts in order to expedite the process.<sup>87</sup>

All of the identifiable 1943 construction projects, with the exception of those at Corpus Christi, were located on the West Coast and appear to have been made in an attempt to augment organizational operations for training units rotating to the Pacific. Corpus Christi, however, did receive two new auxiliary fields at Beeville and Field 21305 — each of which received a single hangar — and Kingsville received a second hangar as well. No details about any of these new structures are available.

Alameda received a new auxiliary field at Fallon, NV. This installation was actually an old Army field that had been declared excess to Air Forces needs as that service began to draw down its training operations. When the Navy assumed control of the site, it erected two new standard Army Type OBH-2 hangars with the typical wood bow-truss construction (Figure 4-32). It is possible that the Army actually erected these structures, or had planned for their construction before releasing the base.

New work began at an operational station in Astoria, OR, in January 1943. This field received two timber hangars, and an auxiliary field at North Bend also got one wooden hangar. No details are available. The Navy also took over an old municipal field at Klamath Falls, OR, but this field already had some hangars, so no new technical construction was necessary. The Navy abandoned the site at the close of hostilities.

Kaneohe Bay received a new A&R Shop in April 1943. This structure displays the typical flat-gable profile with the familiar peaked central monitor found on so many other shops of this type throughout the U.S. However, it lacks the massive corner piers of its predecessors, and its 160 x 240 ft dimensions may suggest that some use was made of the standard 240 ft trusses common to the B-M Seaplane hangars found at that installation (Figure 4-33). Finally, two Aleutian Island bases were established at Attu and Kiska following those islands' liberation from Japanese forces in May and August 1943, respectively. Attu received eight Kodiak-type landplane hangars while Kiska received only a nose dock measuring 30 x 150 ft. Both projects were scheduled to have been completed by September 1943.<sup>88</sup>

#### **The Construction Slowdown of 1944 and 1945**

Beginning with the Naval Appropriations Act of 1944, Congress began to resume its traditional oversight of naval appropriations requests. This act was passed in January 1944, granting \$281 million for the liquidation of outstanding contracts and a further \$475 million in contract authorization for which no funding was approved. This was done in order that, should hostilities end abruptly, no extra funds would be left in naval hands to be returned later. The funding necessary for the approved projects was provided by the First Deficiency Appropriations Act of 1945.

Congress was clearly no longer willing to allow the sort of blank-check approval that had dominated the process in the early years of the war. In fact, it struck out a number of items requested by the Navy, on the grounds that they were unnecessary. In particular, about \$14 million in aviation projects was refused because they could be accomplished by acquiring some excess facilities that the Army was already looking to liquidate. Transcripts of the congressional hearings contain a great deal of discussion about using excess Army facilities rather than constructing new ones. In fact, extensive investigations by committee members spurred significant new action by Navy and Army officials to closely coordinate on this issue. By March 1945, more than 30 excess Army installations had passed to Navy control. Only overseas advanced base projects were left entirely up to naval officials' discretion, and \$1 billion was approved for this type of con-

struction. Clearly, *ad hoc* wartime funding practices had come to an end, and little new construction was approved for the Navy despite protestations that the war in the Pacific might continue for years.

The Naval Appropriations Act of 1946, which passed in May 1945 — 3 weeks after V-E Day — brought more of the same. A return to an itemized budget and pressure from Congress to reduce appropriations for all activities within the U.S. left very little support for construction at the Navy's air stations. Requests for \$514 million were cut to \$288 million. (However, the entire amount of \$986 million requested for overseas expansion was passed without comment.) There was even open speculation in Congress that the Navy might be taking advantage of the wartime situation to "get while the getting was good" in order to finance its post-war shore establishment under the guise of wartime necessity. In such an atmosphere, then, it is not surprising that immediately following the Japanese surrender on 2 September 1945, Congress passed a series of rescission acts that drastically cut even these reduced appropriations, and all unobligated funds were revoked prior to the passage of the FY47 budget.<sup>89</sup>

Few details are available about the remaining late construction efforts. Miami received a single hangar in 1944, and Key West received two additional hangars in the same year to augment the B-M Seaplane Hangar built in 1940. These double-bay hangars were constructed with steel and wood framing, with wood cladding. In 1945, Astoria and Pasco each received a single hangar, and Alameda received two steel-framed hangars. No additional details are available.

Clearly, the wartime naval aviation construction effort was finished as Congress quickly slashed defense spending in anticipation of life after the war. All construction deemed superfluous to the successful conclusion of the war was halted.<sup>90</sup>

### ***The Legacy of WWII Naval Aviation***

U.S. naval air power came of age during WWII, growing into a mature and predominant military asset. The war in the Pacific forcefully demonstrated the indispensable role of the air arm in modern naval warfare, and the war's outcome served as a full vindication of all for which its advocates had argued for over the preceding generation.

As the aircraft carrier took its place as the capital ship in the fleet, the aviation arm could no longer be viewed as a poor stepchild of the Navy. In fact, the aircraft carrier would constitute the Navy's premiere strategic asset in future inter-service funding rivalries during the coming Cold War period.

The Marine Corps had once again proven its fighting mettle, and had validated its peculiar amphibious warfare mission in the Pacific. Within that mission, Marine Corps close air support had played a crucial role, and one that was widely accepted as an inherent component of any future Marine Corps doctrine.

Moreover, the expansion of the Navy's aviation shore establishment in support of this unprecedented war effort had placed it in a secure position to resist the fiscal cutbacks of the coming Cold War years. While little substantial expansion had actually been done after the first year of warfare, the immense effort expended during the pre-1942 mobilization had laid such a firm foundation of support that relatively little more had to be done to support the incredible wartime expansion. While the Marine Corps had to await U.S. entry into war to receive its big push, the results of its 1942 construction campaign are wholly comparable to those of the Navy. It is significant that the vast majority of both the Navy's and the Marine Corps' present-day aviation shore installations were already in operation or under development at the time of the Pearl Harbor attack, or were completed for the Marines in that first year. Much expansion was supported at the Navy's installations in the dark days of 1942, but few entirely new air stations had to be started from the ground up. The Hepburn and Greenslade programs had proven very successful indeed in providing for naval aviation those facilities necessary to expand to a wartime footing. The results of these construction programs can be seen at almost every Naval Air Station in service today.

**Table 4-1. Second World War, U.S. Army Air Forces and Army Organic aviation.**

	1939 – 40	1941 – 42	1943 – 45
<b><i>Military Conflicts</i></b>	<p>August 1939: Germans invade Poland</p> <p>June 1940: Germans occupy Paris</p> <p>7 December 1941: Japanese attack on Pearl Harbor</p>	<p>22 June 1941: German troops invade Soviet Russia</p>	<p>8 May 1945: World War II ends in Europe</p> <p>6 August 1945: Atomic bomb dropped on Hiroshima</p> <p>9 August 1945: Atomic bomb dropped on Nagasaki</p> <p>14 August 1945: World War II ends in the Pacific</p>
<b><i>Air Forces / Army Organic Aircraft</i></b>		<p>June 1942: B-24 Liberator flies first bombing missions against German-held territory in Romania</p> <p>September 1942: Training for organic army artillery observation done in Piper L-4B's, Taylorcraft L-2B's, and Aeronca L-3C's</p>	
<b><i>Air Forces / Army Organic Aviation Operations</i></b>	<p>June 1940: General Ben Lear recommends that light aircraft be a permanent component of artillery units for artillery observation</p>	<p>June 1942: First attacks on German-controlled Europe by American bombers</p>	<p>June 1944: Operation Overlord carried out by Air Force to provide effective air support to allied armies</p> <p>6 August 1945: B-29 <i>Enola Gay</i> drops first atomic bomb on Japan</p> <p>9 August 1945: B-29 <i>Bock's Car</i> drops second atomic bomb on Japan</p>
<b><i>Air Forces / Army Organic Aviation Administration</i></b>	<p>April 1939: Expansion of Air Corps to 24-Group strength (6,000 aircraft)</p> <p>1940: Roosevelt calls for 50,000-plane Air Corps</p> <p>December 1940: First Aviation Objective of 54 combat groups authorized</p>	<p>March 1941: Second Aviation Objective of 84 combat groups authorized</p> <p>June 1941: War Department creates the U.S. Army Air Forces</p> <p>September 1941: General Staff's Air War Plans Division publishes long-range strategic forecast that advocates an Air Force of 239 combat groups</p> <p>December 1941: 239 combat group plan put into place</p> <p>6 June 1942: Organic army aviation is authorized</p>	<p>April 1944: 20<sup>th</sup> Strategic Air Force is organized. Only command to fly the B-29 Superfortress. Only armed force in the history of man to employ nuclear weapons against an enemy.</p>
<b><i>Construction Support for Air Forces / Army Organic Aviation</i></b>	<p>April 1939: Expansion of base facilities under the Wilcox Act Expansion</p> <p>November 1940: Oversight of Air Corps construction programs officially passed to Corps of Engineers</p>	<p>February 1941: Final transfer of construction programs to Corps of Engineers</p>	<p>February 1944: General Arnold orders that no further construction be undertaken in the continental U.S. without his personal approval</p>

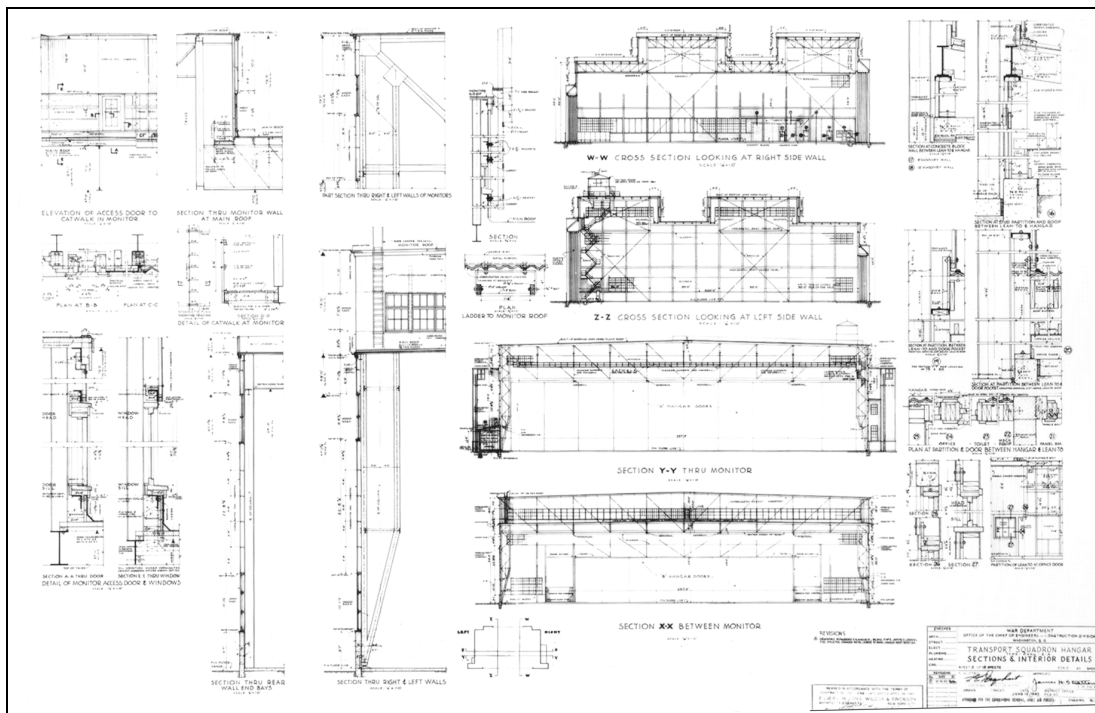
Table 4-2. Second World War, U.S. Navy and Marine Corps aviation.

	1939 – 40	1941 – 42	1943 – 45
<i>Military Conflicts</i>	June 1940: Germans occupy Paris 7 December 1941: Japanese attack on Pearl Harbor	22 June 1941: German troops invade Soviet Russia	8 May 1945: World War II ends in Europe 14 August 1945: World War II ends in the Pacific
<i>Navy / Marine Corps Aircraft</i>	1940: Grumman F4F Wildcat is introduced and is mainstay fighter until introduction of the F4U	1942: Vought F4U Corsair enters service with the U.S. Marine Corps providing air superiority over the Japanese Zero in the Pacific 3-6 June 1942: Douglas SBD Dauntless dive bombers stop the Japanese at the Battle of Midway	1943: Grumman F6F Hellcat enters service. Called the most significant aircraft of WWII. Accounts for almost 75 percent of all Navy and Marine air-to-air victories
<i>Navy / Marine Corps Aviation Operations</i>	5 September 1939: Navy establishes Neutrality Patrols along the east coast of the U.S.		
<i>Navy / Marine Corps Aviation Administration</i>	14 June 1940: 4,500 plane program authorized 15 June 1940: 10,000 plane program authorized 19 July 1940: 15,000 plane program authorized. Legislation provides for latitude given to the Secretary of the Navy to provide, with Presidential approval, additional aircraft as circumstances proved necessary 1939: Hepburn Board convenes to recommend air station developments	1942: Aircraft production goes from 500/month to 1,500/month or 18,000 per year 1942: Supplemental National Defense appropriations total more than \$80,000,000 for aviation facilities in support of the expanding aircraft numbers 1942: 27,500 plane program authorized	
<i>Construction Support for Navy / Marine Corps Aviation</i>	1939: Army vacates Rockwell Field and the Navy takes beneficial occupancy 25 April 1939: 1940 appropriation act covers authorization of Hepburn recommendations over 3 year period. \$65,000,000 appropriated for 14 air stations	1942: 26 naval air stations are established in the U.S. in support of 27,500-plane program	





**Figure 4-1. Typical Air Depot Aircraft Hangars (background) and typical Transport Squadron Hangar under construction (right foreground) at Griffiss Air Force Base, NY.** (Source: Archives at Griffiss Air Force Base, NY.)



**Figure 4-2. Plan No. 1000-357, Transport Squadron Hangar, ca. 1942.** (Source: 105mm film archives at U.S. Army Corps of Engineers History Office, Fort Belvoir, VA.)

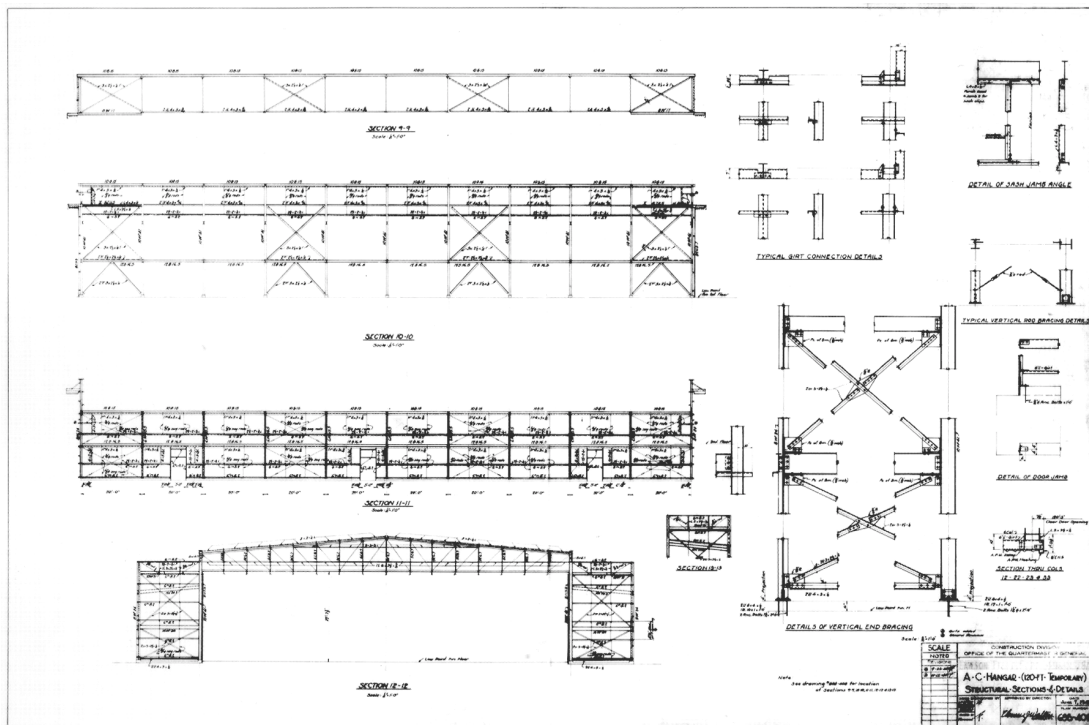


Figure 4-3. Plan No. 695-409, 120-Foot Temporary Hangar, ca. 1940. (Source: 105mm film archives at U.S. Army Corps of Engineers History Office, Fort Belvoir, VA.)

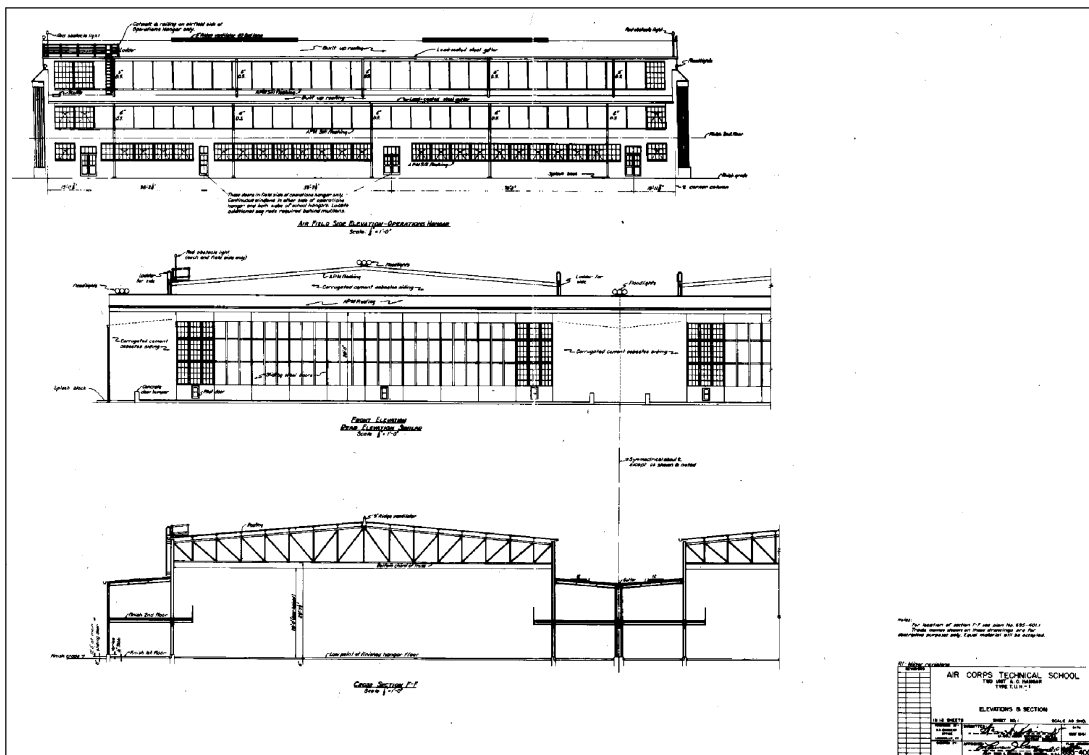


Figure 4-4. Plan No. 695-400.1, Air Corps Technical School, Two-Unit Hangar (Type TUH-1), ca. 1941. (Source: 105mm film archives at U.S. Army Corps of Engineers History Office, Fort Belvoir, VA.)



**Figure 4-5. Transport Squadron Hangar at Griffiss Air Force Base, NY.** (Source: Earthtech, Colton, CA.)



**Figure 4-6. 184-Foot Demountable Hangar (Type DH-1) at Vance Air Force Base, OK.** (Source: Archives at Vance Air Force Base, OK.)





Figure 4-7. Possible CAA or modified DH-1 Hangar at Reese Air Force Base, TX. (Source: Archives at Reese Air Force Base, TX.)

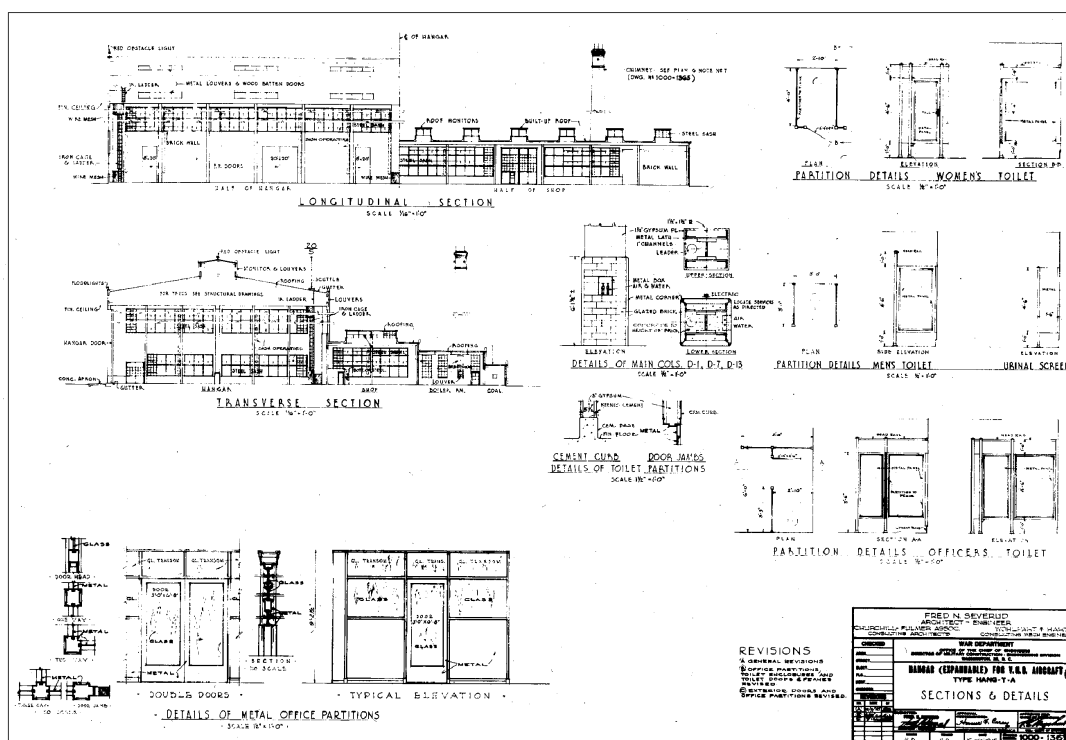
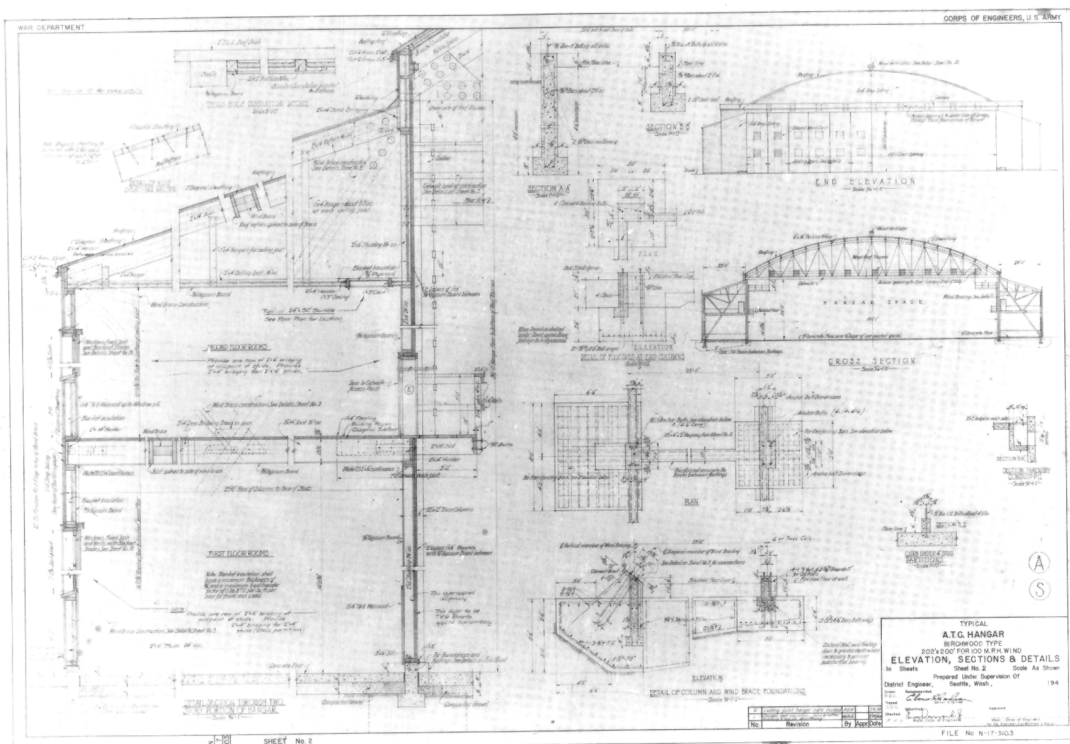


Figure 4-8. Plan No. 1000-1367, Hangar (Expandable) for V.H.B. Aircraft (Type HANG-T-A), ca. 1945. (Source: 105mm film archives at U.S. Army Corps of Engineers History Office, Fort Belvoir, VA.)

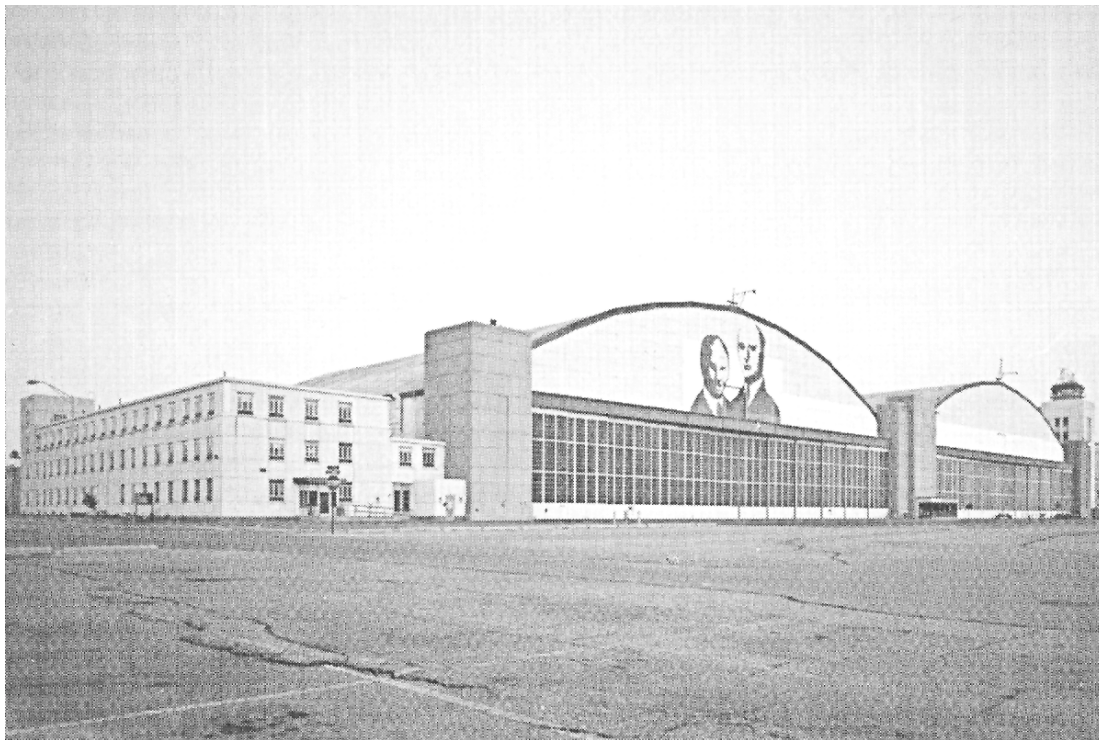


**Figure 4-9. Two-Unit Hangars at Keesler Air Force Base, MS.** (Source: Archives at Keesler Air Force Base, MS.)



**Figure 4-10. Plan of the A.T.C. Birchwood-Type Hangar, ca. 1944.** (Source: 105mm film archives at U.S. Army Corps of Engineers History Office, Fort Belvoir, VA.)





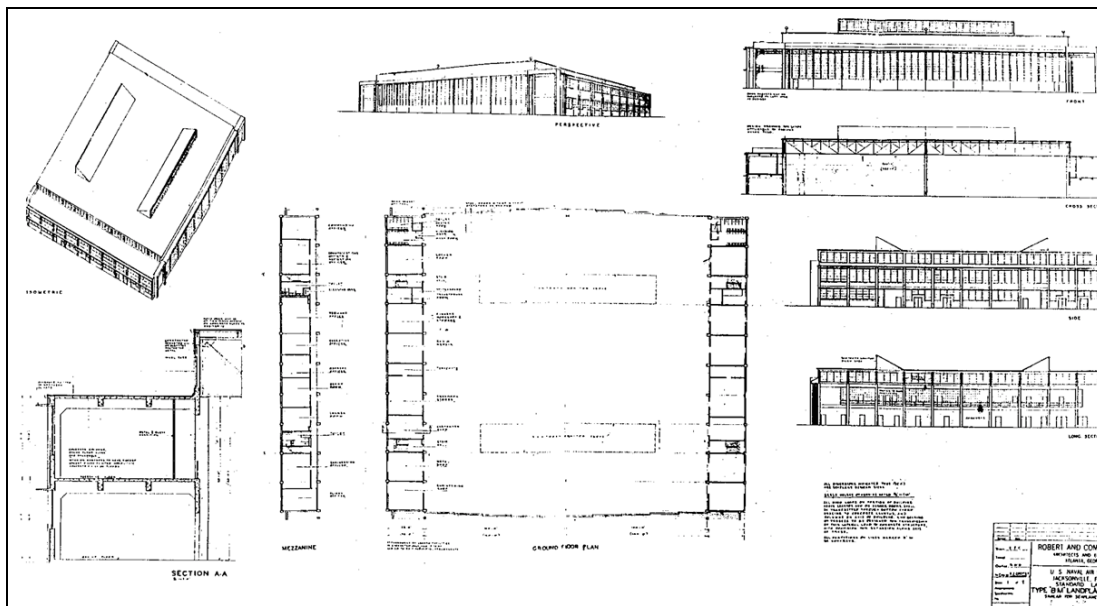
**Figure 4-11. Non-standard flight test hangars at Wright-Patterson Air Force Base, OH.** (Source: Emma J.H. Dyson, Dean A. Herrin, and Amy E. Slaton, *The Engineering of Flight: Aeronautical Engineering Facilities of Area B, Wright-Patterson Air Force Base, Ohio*, [Washington, DC: National Park Service, U.S. Department of the Interior, 1993], p 42.)



**Figure 4-12. 120-Foot Temporary Hangar at Eglin Air Force Base, FL.** (Source: Archives at Eglin Air Force Base, FL.)



**Figure 4-13. Standard Type R-A Heavy Bombardment Hangar at Maxwell Air Force Base, AL.**  
(Source: Archives at Maxwell Air Force Base, AL.)



**Figure 4-14. Roberts & Company, Inc. Type B-M Landplane/Seaplane Hangar standard plan, ca. 3 March 1941.** (Source: Cartographic and Architectural Branch, NARA, RG 71, BY&D Drawings on Film, Roll 635, Frame 649-45-106.)





**Figure 4-15. Aircraft Storehouse (Bldg 631) at NAS Pensacola.** (Source: Photograph by Aaron Chmiel, CERL.)



**Figure 4-16. Seaplane Hangar (Bldg 632) at NAS Pensacola.** (Source: Photograph by Aaron Chmiel, CERL.)





**Figure 4-17. B-M Landplane Hangar (Bldg 115) at NAS Jacksonville.** (Source: Archives at NAS Jacksonville, FL.)



**Figure 4-18. B-M Seaplane Hangar (Bldg 123) at NAS Jacksonville.** (Source: Archives at NAS Jacksonville, FL.)

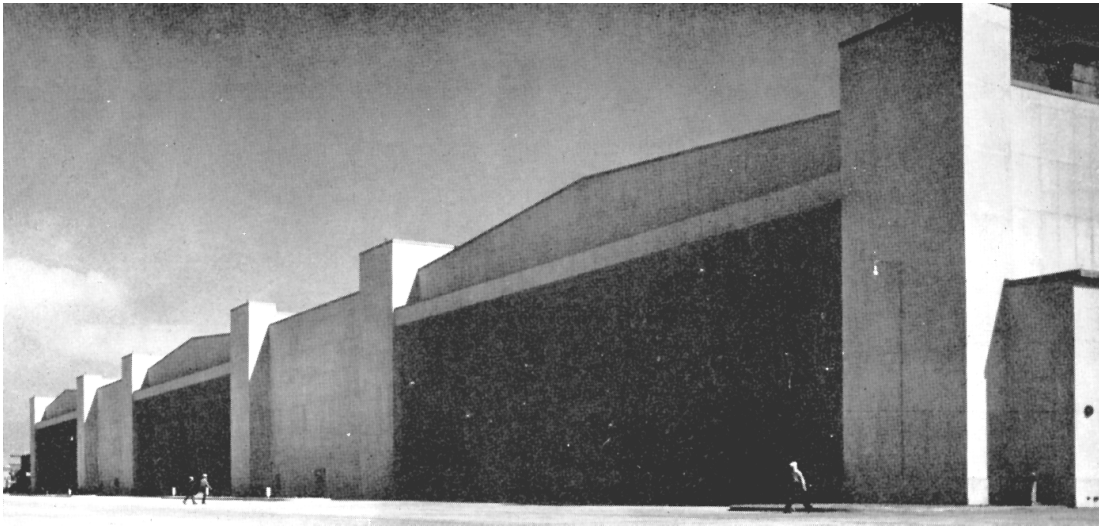


**Figure 4-19. Half B-M Landplane Hangar (Bldg 117) at NAS Jacksonville.** (Source: Archives at NAS Jacksonville, FL.)

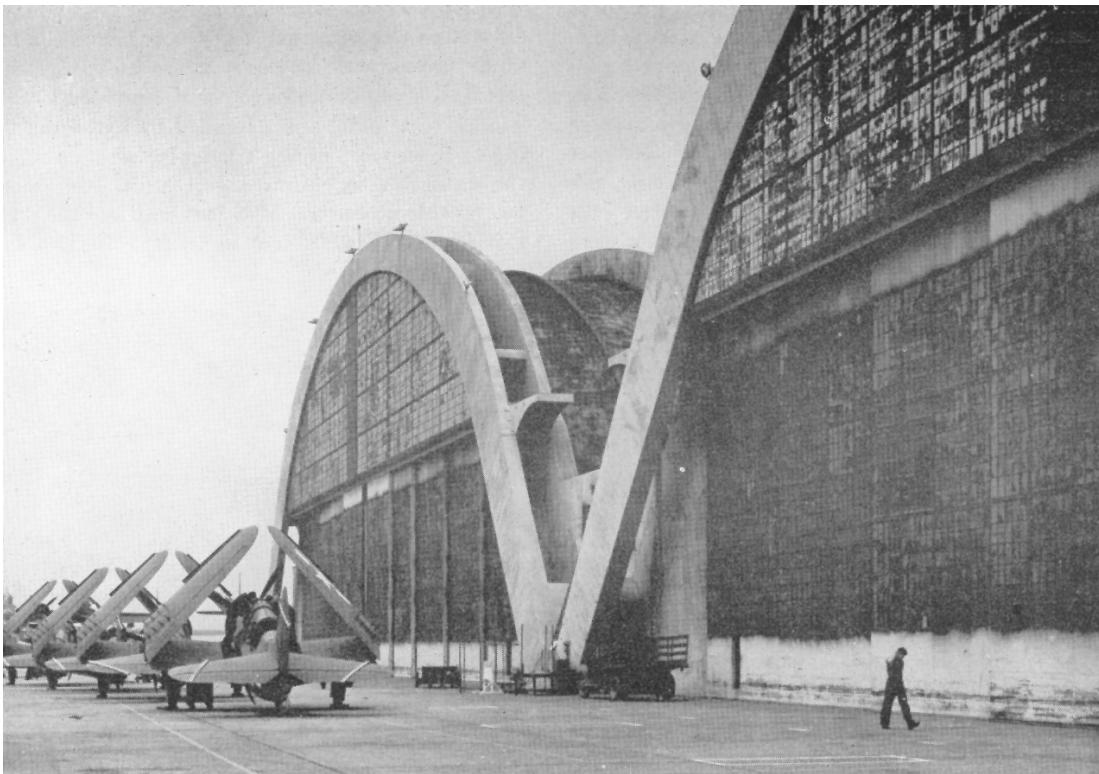


**Figure 4-20. A&R Shop at NAS Jacksonville.** (Source: *Building the Navy's Bases in World War II, History of the Bureau of Yards and Docks and Civil Engineer Corps, 1940 – 1946, Volume I*, [Washington, DC: U.S. Government Printing Office, 1947], p 243.)

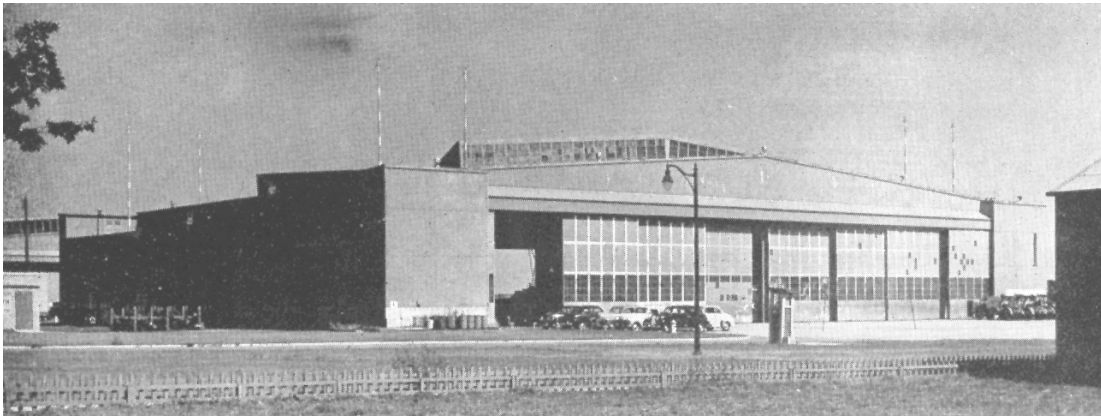




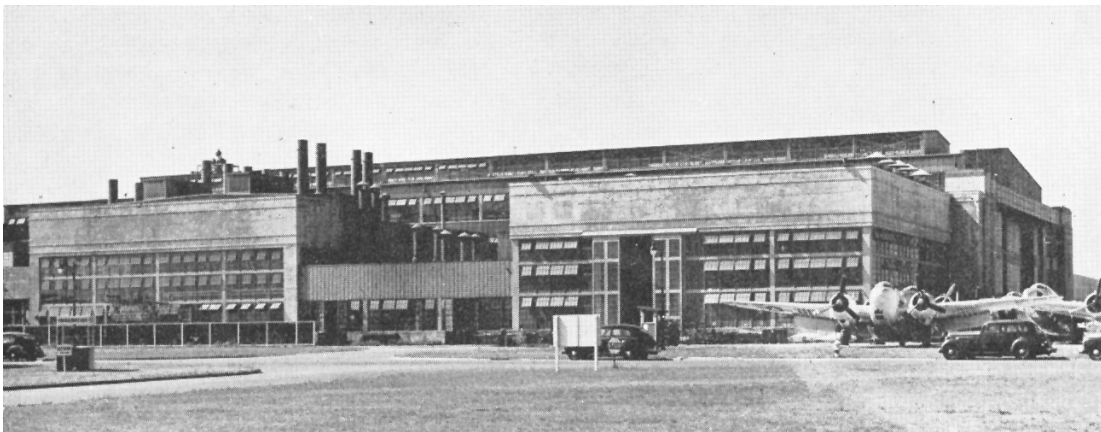
**Figure 4-21. A&R Shop Hangars at Alameda.** (Source: *Building the Navy's Bases in World War II, History of the Bureau of Yards and Docks and Civil Engineer Corps, 1940 – 1946, Volume I*, [Washington, DC: U.S. Government Printing Office, 1947], p 245.)



**Figure 4-22. Monolithic concrete hangar at NAS North Island, CA, ca. 1941.** (Source: *Building the Navy's Bases in World War II, History of the Bureau of Yards and Docks and the Civil Engineer Corps, 1940 – 1946, Volume I*, [Washington, DC: U.S. Government Printing Office, 1947], p 241.)

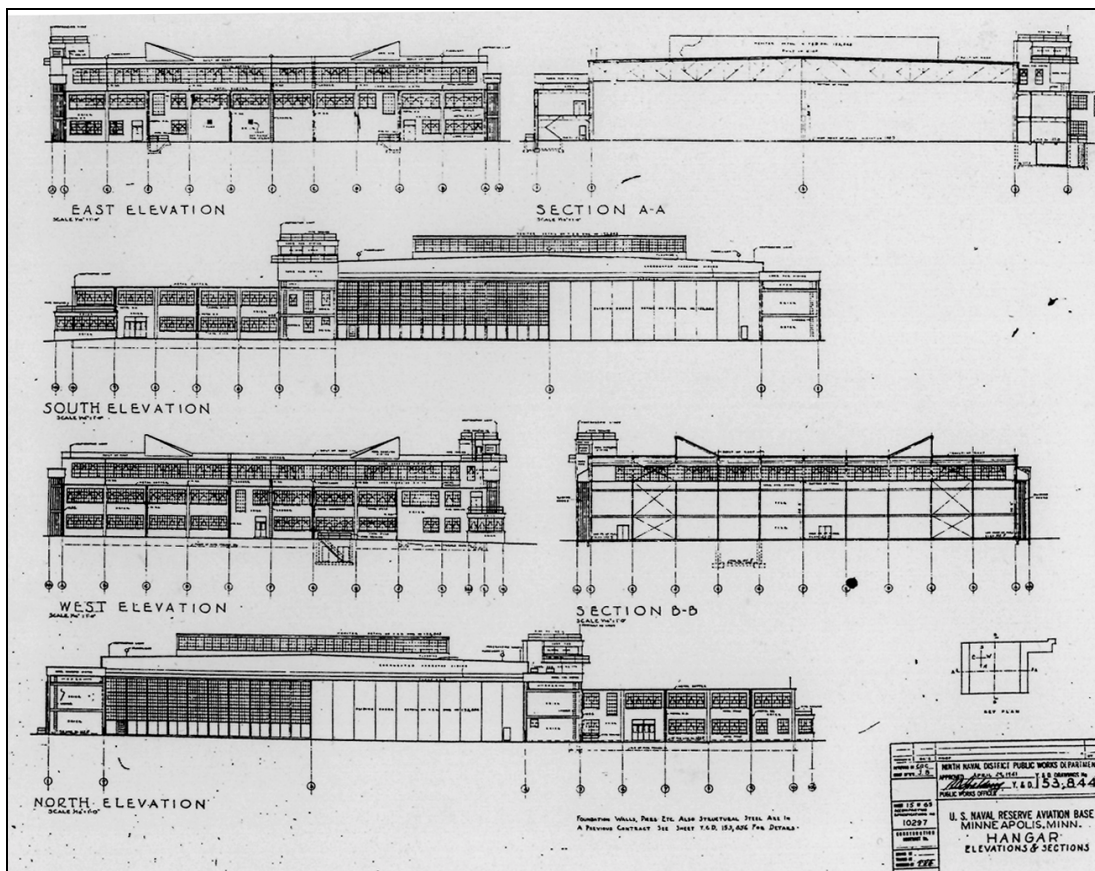


**Figure 4-23. Landplane Hangar at Quonset Point, RI.** (Source: *Building the Navy's Bases in World War II, History of the Bureau of Yards and Docks and Civil Engineer Corps, 1940 – 1946, Volume I*, [Washington, DC: U.S. Government Printing Office, 1947], p 235.)



**Figure 4-24. A&R and Engine Overhaul Shop at Quonset Point, RI.** (Source: *Building the Navy's Bases in World War II, History of the Bureau of Yards and Docks and Civil Engineer Corps, 1940 – 1946, Volume I*, [Washington, DC: U.S. Government Printing Office, 1947], p 246.)





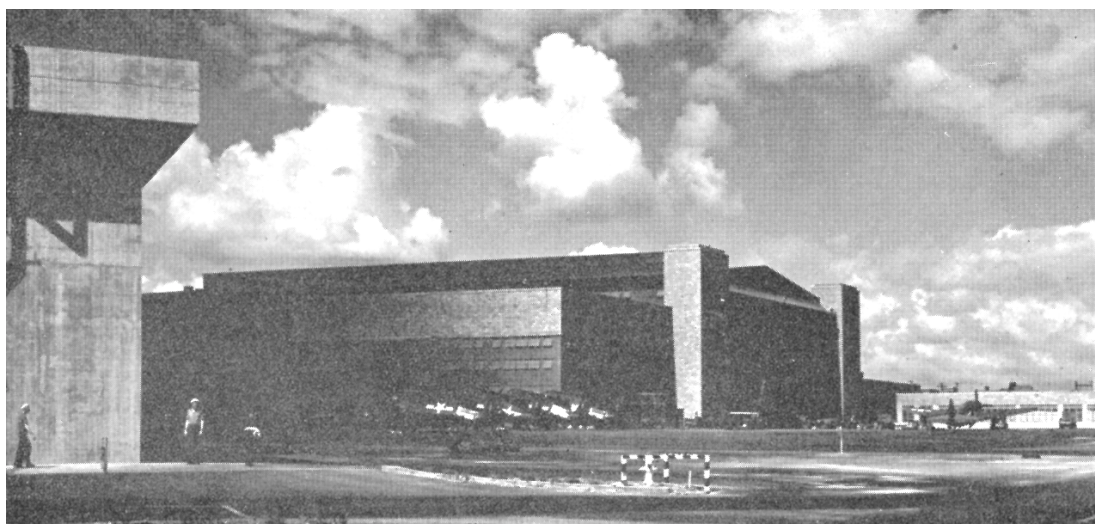
**Figure 4-25. Modified B-M Landplane Hangar for Reserve air bases, ca. 1941.** (Source: Cartographic and Architectural Branch, NARA, RG 71, BY&D Drawings on Film, Roll 1005, Frame unknown.)



**Figure 4-26. A&R Shop Hangar at Cherry Point, NC.** (Source: *Building the Navy's Bases in World War II, History of the Bureau of Yards and Docks and Civil Engineer Corps, 1940 – 1946, Volume I*, [Washington, DC: U.S. Government Printing Office, 1947], p 258.)



**Figure 4-27. Steel LTA Hangars (Bldgs 148 and 149) at Lakehurst, NJ.** (Source: Official Navy Photograph; archives at NAS Lakehurst, NJ.)

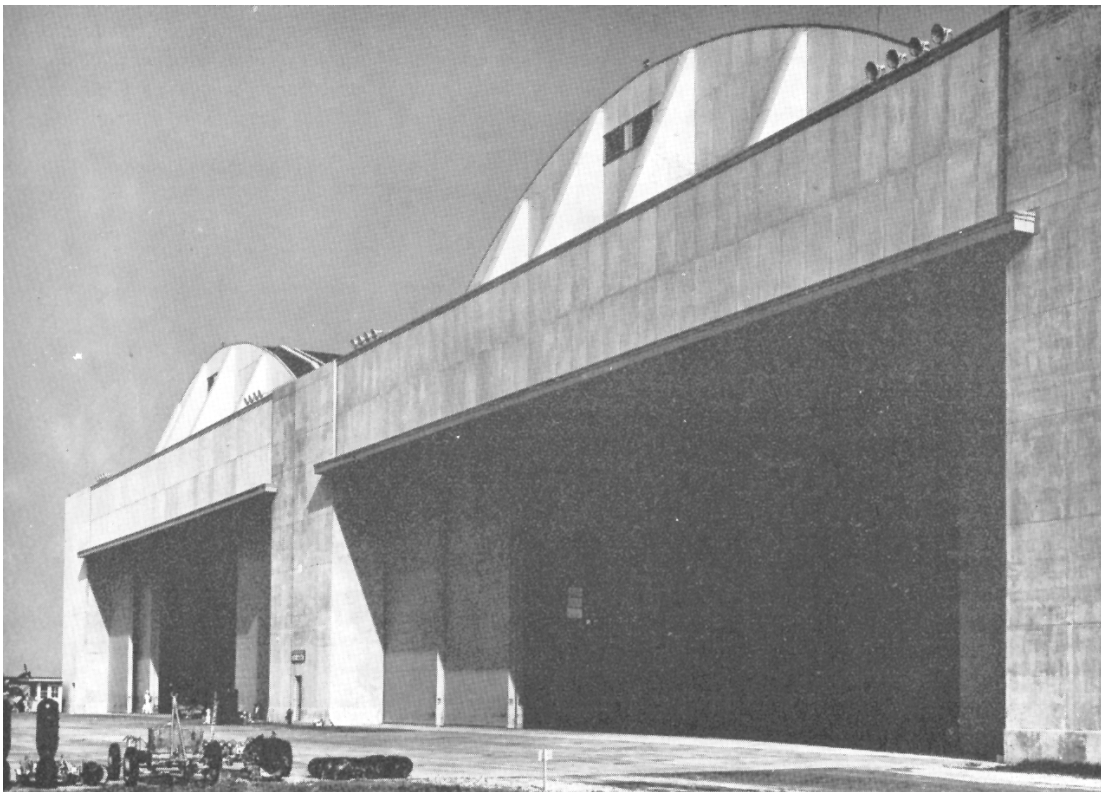


**Figure 4-28. A&R Shop at NAS Barbers Point.** (Source: *Building the Navy's Bases in World War II, History of the Bureau of Yards and Docks and Civil Engineer Corps, 1940 – 1946, Volume II*, [Washington, DC: U.S. Government Printing Office, 1947], p 140.)





**Figure 4-29. Standard B-M Type Hangars at NAS Memphis.** (Source: *Building the Navy's Bases in World War II, History of the Bureau of Yards and Docks and Civil Engineer Corps, 1940 – 1946, Volume I*, [Washington, DC: U.S. Government Printing Office, 1947], p 238.)



**Figure 4-30. Twin Reinforced Concrete Hangar at Patuxent River, MD.** (Source: *Building the Navy's Bases in World War II, History of the Bureau of Yards and Docks and Civil Engineer Corps, 1940 – 1946, Volume I*, [Washington, DC: U.S. Government Printing Office, 1947], p 249.)



**Figure 4-31. Timber LTA Hangars (Bldgs 194 and 195) at NAS Lakehurst.** (Source: Official Navy Photograph; archives at NAS Lakehurst, NJ.)



**Figure 4-32. Army Type Squadron OBH-2 (Wood) Hangar at NAS Fallon, NV.** (Source: Archives at NAS Fallon, NV.)





**Figure 4-33. A&R Shop Hangar at NAS Kaneohe, HI.** (Source: *Building the Navy's Bases in World War II, History of the Bureau of Yards and Docks and Civil Engineer Corps, 1940 – 1946, Volume II*, [Washington, DC: U.S. Government Printing Office, 1947], p 138.)

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